June 6, 1960

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USAF Planning Environmental Space Chamber

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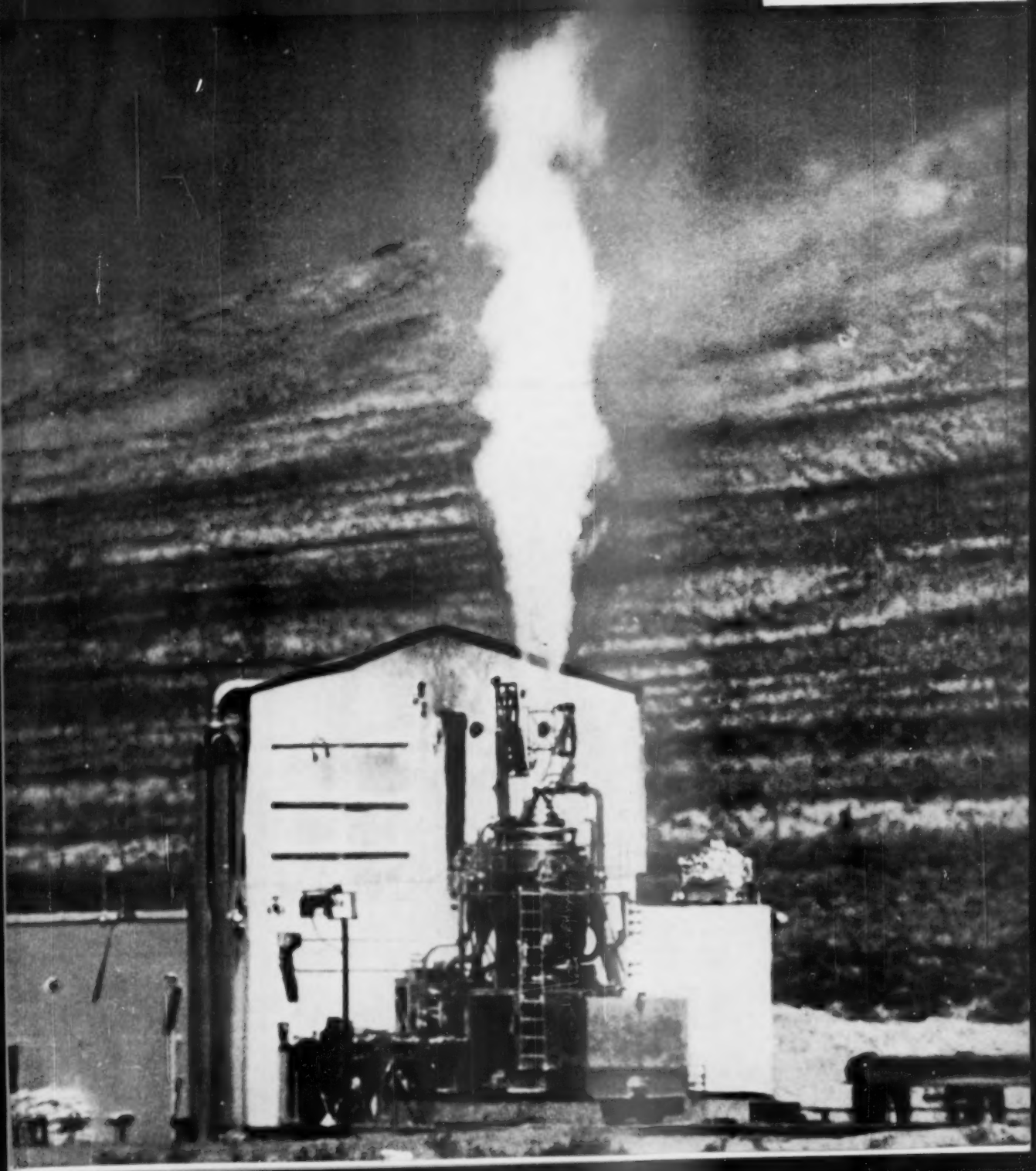

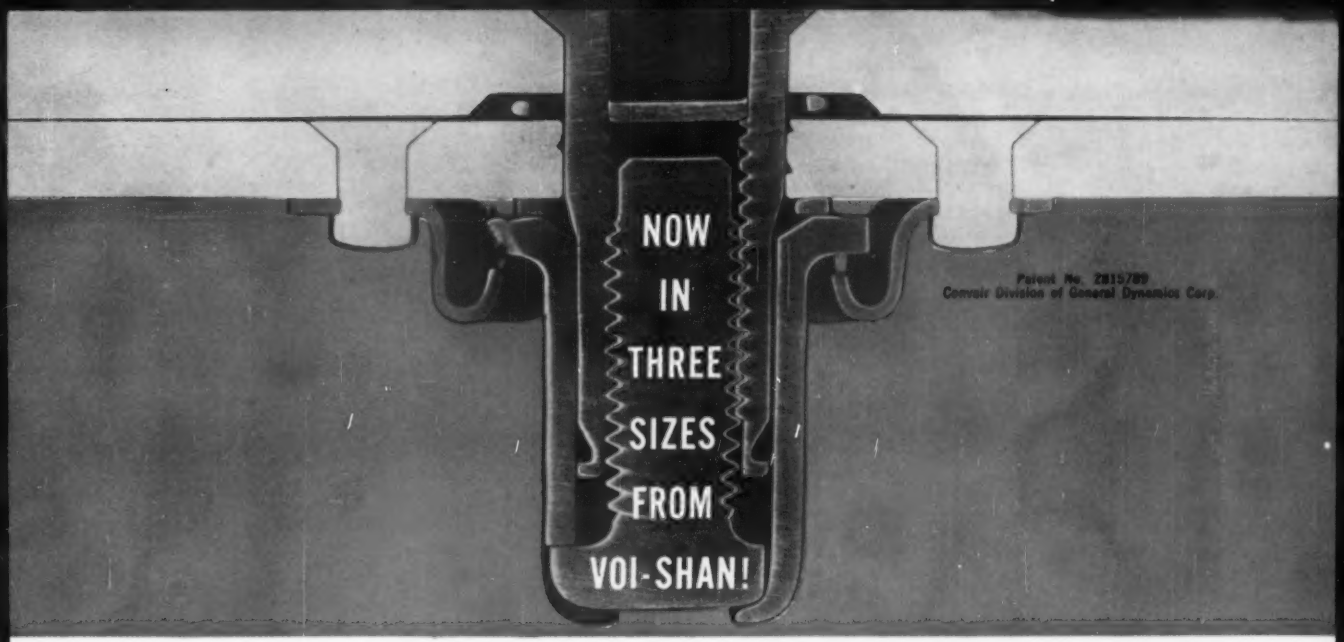

MILSON STRUCTURAL PANEL FASTENERS

Now Voi-Shan's three sizes bring all the advantages of Milson Fasteners to almost any application that calls for quickly removable structural panels. Milson Fasteners make the panel an integral part of the primary structure—yet permit fast, repeated access to equipment behind the panel. Voi-Shan's three structural sizes, ¼", 5/16", ⅜", two sleeve bolt head styles, five receptacle configurations, and two temperature ranges permit maximum design flexibility.

Milson Fasteners close gaps up to .125 in. with four or less turns—permit hole misalignments up to .040 in. Self-locking, they have only four parts, need no adjustment, and can be re-used 350 or more times. Deep hex socket provides quick tool insertion, high preload, superior power driving, and longest recess life. Milson Fasteners have common hole size in the panel and substructure and all parts are completely interchangeable, available in alloy steel for temperatures to 550°F; in corrosion-resistant steel to 700°F; and with self-sealing receptacles.

For new brochures, further information, prices, and/or technical assistance on this and other quality fastener products, you are invited to contact Voi-Shan's Sales Service Department.

COMPARISON CHART:

SIZE	DIAMETER	SINGLE SHEAR	ULTIMATE TENSILE	RIVET SPACING
Milson 1900-4	.250	2,250	2,000	.688—.750
NAS 547 #0	.312	2,720	1,290	.750
Milson 1900-5	.312	4,750	3,500	.875
NAS 547 #1	.375	4,650	2,210	.875
Milson 1900-6	.375	6,500	6,000	.875—1.000

Milson 1910 Protruding Head Sleeve Bolt*

Milson 1920 Flush Head Sleeve Bolt*

Milson 1950 Standard Two-Lug Receptacle Assembly*

Milson 1955 Reduced Rivet Spacing Receptacle Assembly*

Milson 1960 Standard Corner Receptacle Assembly*

Milson 1970 Two-Lug Self-Sealing Receptacle Assembly**

Milson 1980 Corner Self-Sealing Receptacle Assembly**

*In alloy steel for temperatures to 550°F; or corrosion-resistant steel to 700°F.

**In alloy steel; seal material meets applicable requirements for use with aircraft types 1, 2 & 3 fuels per Spec. MIL-R-6855. Applicable temperature range —65°F to +260°F. Applicable pressure range ±50 P.S.I.

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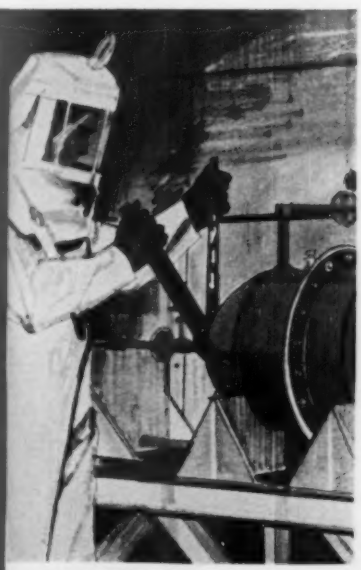

TAMING "WILD" FUELS FOR MISSILE BOOSTERS

Volatile exotic fuels to drive satellites into orbit call for new types of containers. Here Goodyear engineers test advanced expeller, bladder-type cell.

Lots of good things come from

GOODYEAR

Safety Cell—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

a messa[illegible]not alone in their thinking . . . Leonardo da Vinci, engineer, scientist, theorist, was the victim of an age when three centuries had to pass before many of his concepts could be regenerated by other men of vision. ☐ Today's quick minds are the fortunate product of an era when methods, materials and machines can be mated to their needs—an age when a spark of inventiveness ignites a fury of progress. ☐ If such a chain reaction of creativity is characteristic of your group, we invite you to discover how Ex-Cell-O can fuse into your operation a reliable source for precision products amply backstopped by research, development and manufacturing facilities, plus the experience required to help you meet the challenge of your own thoughts. ☐ Contact the Ex-Cell-O Representative in your area, or if you wish, call or write direct to our Aircraft Division's central offices, Detroit.

Artist's conception of Leonardo da Vinci's 15th Century spring-driven aerial screw, predecessor of today's helicopter.

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AVIATION CALENDAR

June 19-24—Summer General Meeting, American Institute of Electrical Engineers, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 22-24—1960 Conference on Standards and Electronic Measurements, NBS Boulder Laboratories, Boulder, Colo. Co-sponsors: Institute of Radio Engineers' Professional Group on Instrumentation; Radio Standards Laboratory, National Bureau of Standards; American Institute of Electrical Engineers' Instrumentation Division.

June 23-25—16th Annual Meeting, Institute of Navigation, U. S. Air Force Academy, Colorado Springs, Colo.

June 26-July 1—63rd Annual Meeting and Apparatus Exhibit, American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 27-29—Fourth National Convention on Military Electronics, Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

June 28-July 1—National Summer Meeting, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif.

July 3-4—Fourth Annual Fort Wayne National Championships (civilian, closed-course airplane races), Fort Wayne, Ind.

July 5-15—Special Summer Program in Inertial Guidance—Terrestrial and Interplanetary, Massachusetts Institute of Technology, Cambridge, Mass.

July 11-12—Conference on Response of Metals to High Velocity Deformation, Stanley Hotel, Estes Park, Colo. Sponsor: Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 28-29—Seventh Annual Symposium on

(Continued on page 6)

AVIATION WEEK and Space Technology

June 6, 1960

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South American Tree Hopper
(Bocydium globulare)
Actual size: 5 mm. high
Courtesy of the American Museum of Natural History

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Competent design engineers will immediately suspect that the tree hopper's awesome pronotum is much too cumbersome to be an efficient antenna. Actually the antennas are just above the eyes.

Like those of the tree hopper, antennas designed by D & M are compact, efficient, and unobtrusive. We make them that way because we know space is at a premium in modern planes and missiles—and because we've had so much experience, with antennas and other RF systems components.

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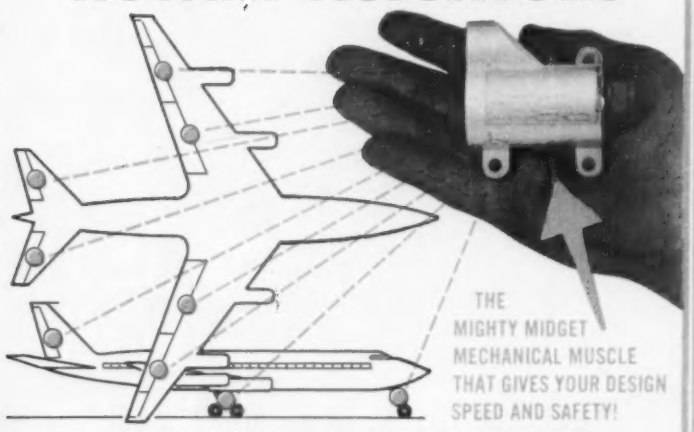

ROTARY ACTUATOR PERFORMANCE REVOLUTIONIZED

The Clemco Aero Products Rotary Hydraulic Actuator provides the most efficient and precise method known for converting hydraulic energy into a desired torque and instantaneous angular position. The extremely low friction, low internal leakage, low backlash and low inertia, realized for the first time in this revolutionary design, combined with the inherent structural advantage of hinge line installation, makes possible systems with lower overall weight and size, higher frequency response and better resolution than is obtainable through other means.

NOW—MINIMUM WEIGHT WITH ABSOLUTE STRUCTURAL INTEGRITY

The heart of this development is a pressure loaded teflon or metal vane seal which is self compensating for wear. In applications where temperature or radiation do not preclude the use of teflon, overall efficiencies as high as 98% and dead band pressure differences as low as 5 P.S.I. with 3000 P.S.I. across the actuator, have been accomplished.

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AVIATION CALENDAR

(Continued from page 5)

Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 1-3—"Future of Manned Military Aircraft" (Classified Meeting), Institute of the Aeronautical Sciences, El Cortez Hotel, San Diego, Calif.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 18-19—Second International Symposium on Submarine and Space Medicine, Laboratory of Aviation and Naval Medicine, Karolinska Institute, Stockholm.

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder, Colo.

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado, Boulder, Colo.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 27-30—Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica, Calif. Cosponsors: USAF; U.S. Army; U.S. Navy; National Aeronautics and Space Administration; Atomic Energy Commission.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

NEW NEW FROM PUROLATOR:

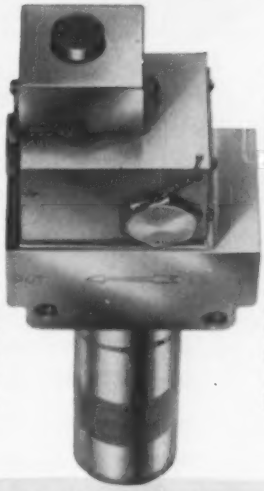
NEW NEW

A FILTER THAT TELLS YOU WHEN IT NEEDS CLEANING

The indicator in the top of this new Purolator filter pops up automatically the moment the element is too clogged to filter accurately. When the element has been cleaned, you simply depress the button until it resets automatically. It stays down, hidden, until the next cleaning is due. That's all there is to it.

WHERE CAN YOU USE IT?

In any fluid system (up to 275°F, 5000 psi) where differential pressure can be used for measurement. The mechanical indicator filter can be made for practically all sizes and operating conditions. It can be designed with or without relief valves and by-pass arrangements.



High filtrate viscosity caused by low temperature won't trigger the indicator because the piston is locked in place below 30°F.

HOW FINE DOES IT FILTER?

Anywhere from 5 to 50 microns, depending on the filtering medium used. Units now in production meet indicator requirements for proposed MIL SPEC: MIL-F-8815.

HOW BIG IS IT—HOW MUCH DOES IT WEIGH?

Check through the chart of standard specifications below. If you want more information, fill in the coupon and mail it to Purolator Products, Inc., Department AW50, Rahway, New Jersey.

STANDARD SPECIFICATIONS

	G-416-1 ASSEMBLY NO. 60878	ASSEMBLY NO. 6652965	ASSEMBLY NO. 6652922
MATERIAL	(Capacity — 5 GPM)	(Capacity — 12 GPM)	(Capacity — 23 GPM)
Head	Aluminum	Aluminum	Aluminum
Case	Aluminum	Aluminum	Aluminum
Element	Stainless Steel Wire Cloth	Stainless Steel Wire Cloth	Stainless Steel Wire Cloth
DIMENSIONS			
Overall	$8\frac{1}{64}$" long x 3" (btw. conn.)	$9\frac{7}{16}$" long x 4" (btw. conn.)	$12\frac{27}{32}$" long x $4\frac{1}{2}$" (btw. conn.)
Element	$1\frac{1}{16}$" O.D. x $3\frac{13}{16}$" long	$1\frac{3}{4}$" O.D. x $4\frac{7}{16}$" long	2" O.D. x $7\frac{3}{8}$" long
Connections	$\frac{3}{8}$-14 UNF-3B (AND 10050-10)	$1\frac{5}{16}$-12 UN-3B (AND 10050-12)	$1\frac{5}{16}$-12 UN-3B (AND 10050-16)
Indicator Actuation	80 PSI at temperatures over 30° ± 20°F	70 PSI at temperatures over 30° ± 20°F	80 PSI at temperatures over 30° ± 20°F
Maximum Operating Pressure	3000 PSI	5000 PSI	4500 PSI
Maximum Operating Temperature	225°F	275°F	275°F
Weight of Complete Unit	1.8 lbs.	4 lbs.	6 lbs.
Degree of Filtration	25 Microns Absolute	25 Microns Absolute	25 Microns Absolute
Element Withstands	3750 PSI	3000 PSI	500 PSI
Relief Valve Setting	None	None	225 PSI

Filtration For Every Known Fluid

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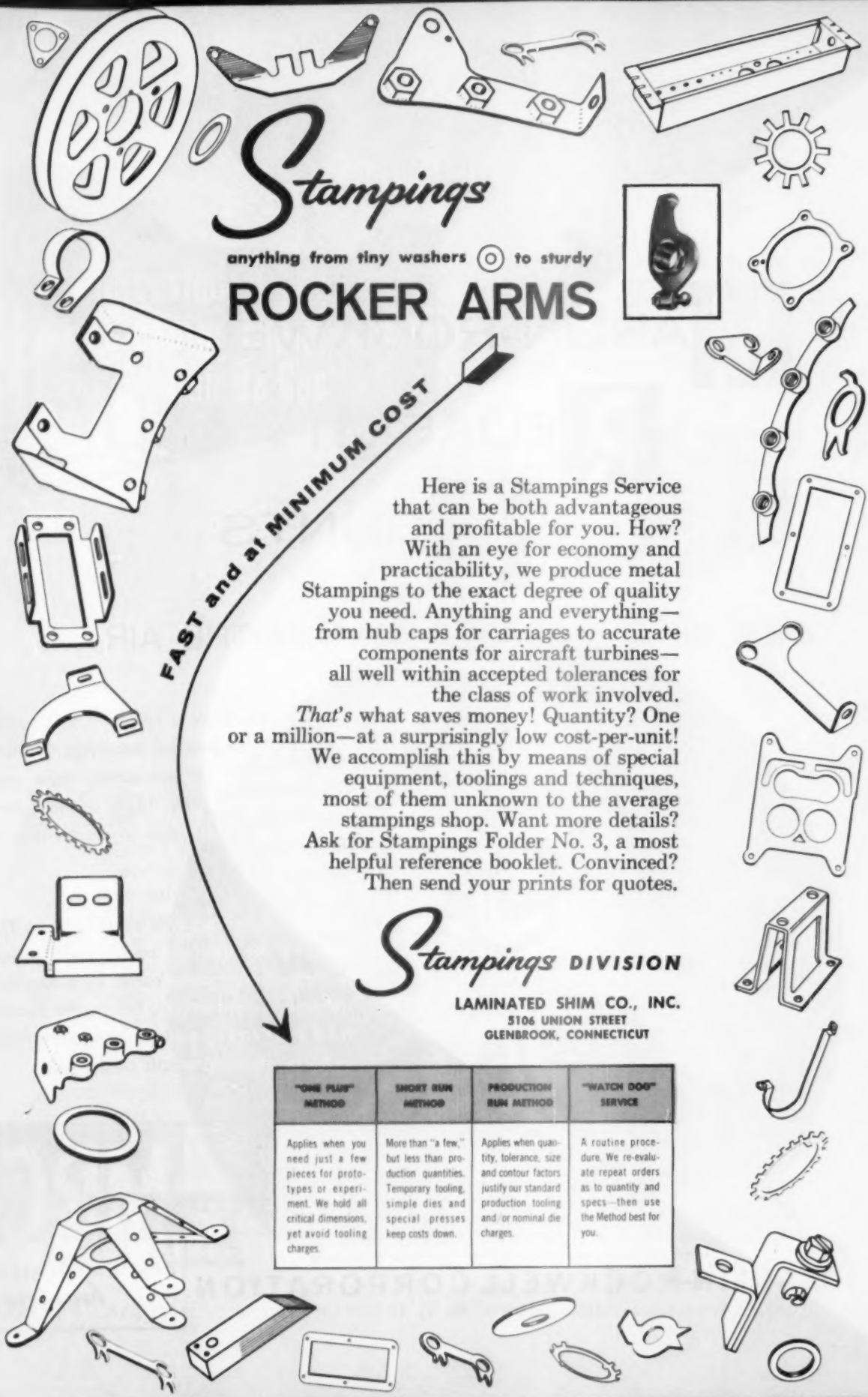

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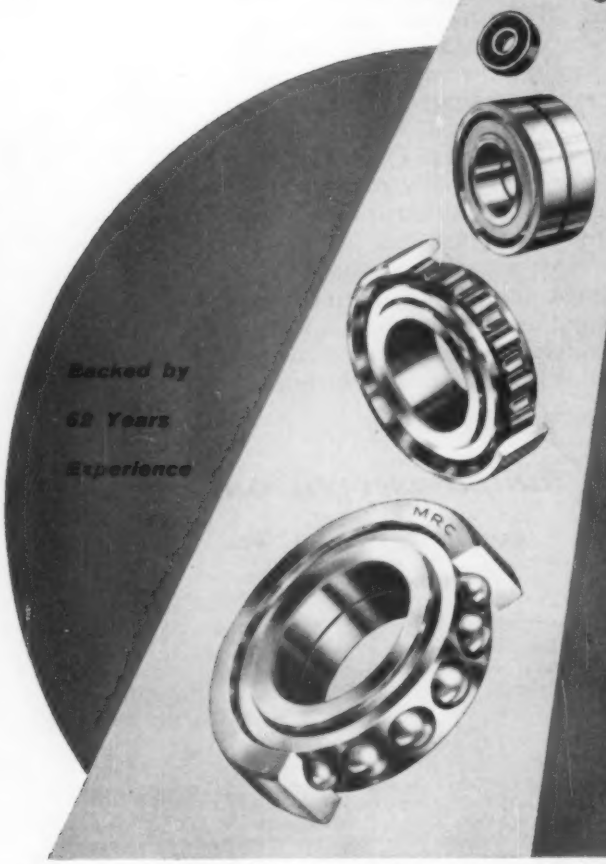

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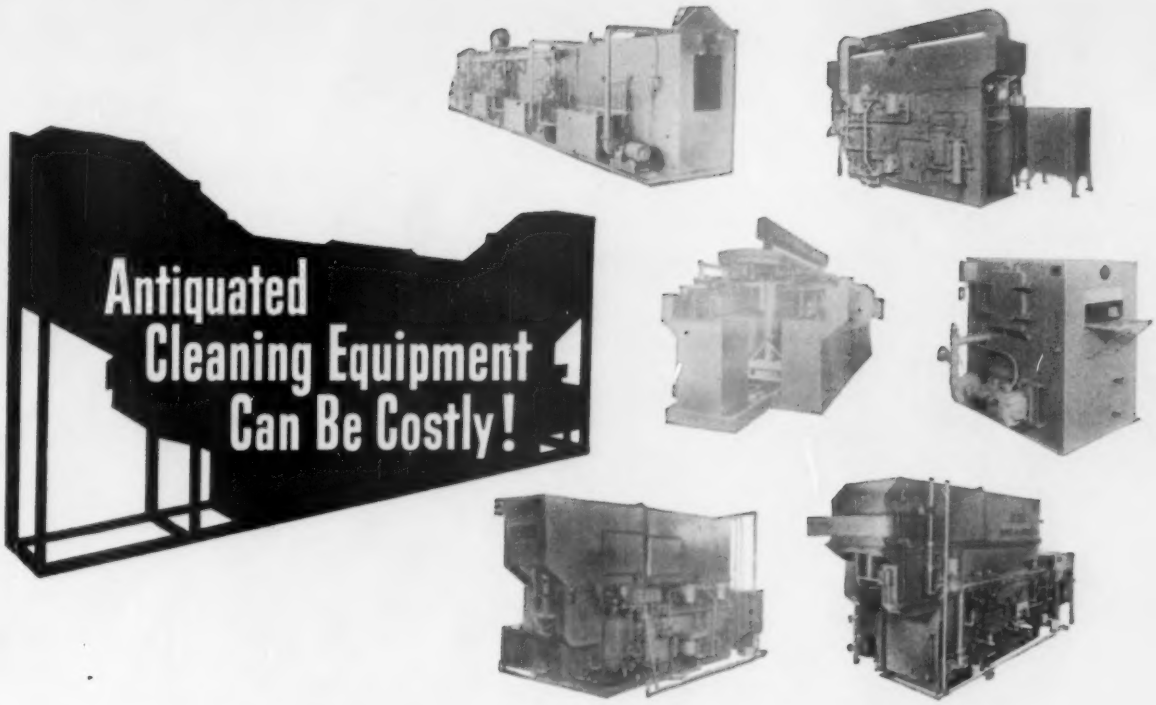

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It is no accident that the Detrex nameplate is found on more cleaning equipment in more metal-working plants than any other—*by a wide margin.* Detrex has had more than 30 years' experience in designing this equipment—has the most complete and modern facilities for producing it—has the largest and most expert field force to help install and service it. And now you can lease any of your cleaning equipment requirements from Detrex. Whether you need a machine for degreasing, washing, rustproofing, phosphate coating, paint-bonding or paint stripping—whether you require equipment that is large or small—whether you desire a manual or automated operation—Detrex can supply your needs exactly and follow through with the service that means complete satisfaction.

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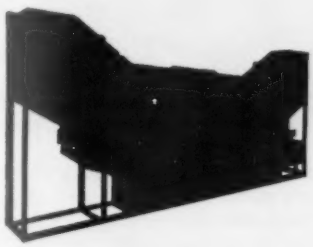
- Spray Booth Compounds



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There is, of course, much to be done before men meet in space. Today, the Northrop Corporation possesses the capabilities and is developing the technologies to help make it possible.

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We've changed our name to

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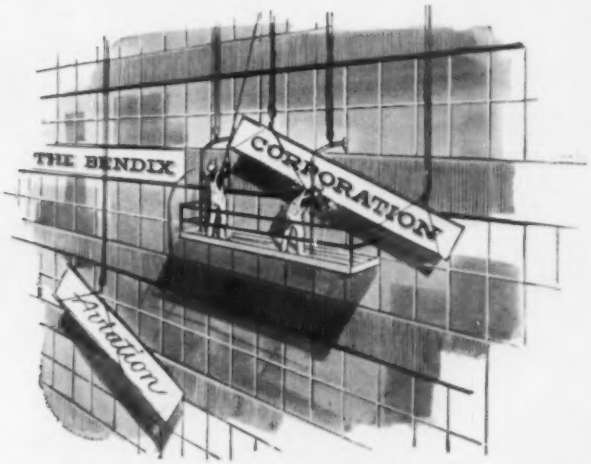

To reflect our dynamic growth in such fields as electronics, missiles and space, automotive, weapons systems, computers, machine tools, instrumentation, nuclear technology, hydraulics, meteorology, electrical, marine and others, we dropped "Aviation" from our corporate name on June 1, 1960. We do not wish to convey the impression that our products and skills are limited to the aviation field alone, although aviation products accounted for billings of $388,700,000 in 1959.

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Our success in the rapidly expanding age of aviation has long obscured the fact that the Bendix automobile starter drive was the company's first major product. Bendix introduced the type of four-wheel brakes that over the years has been used on most makes of cars. Bendix also pioneered automotive power brakes and power steering. Our automotive business in 1959 totaled $114,300,000.

A notable trend in Bendix' recent history is the utilization of electronics in many of our major fields of activity. These range from automobile radios to aircraft and industrial communications and automatic flight controls . . . from electronic computers and data processing to numerical tape control systems for machine tools . . . and from transistors and ship-to-shore telephones to sonic cleaning and undersea sonar detection equipment. Approximately 40% of Bendix products are electronic, including air defense radar which today guards 25 million square miles.

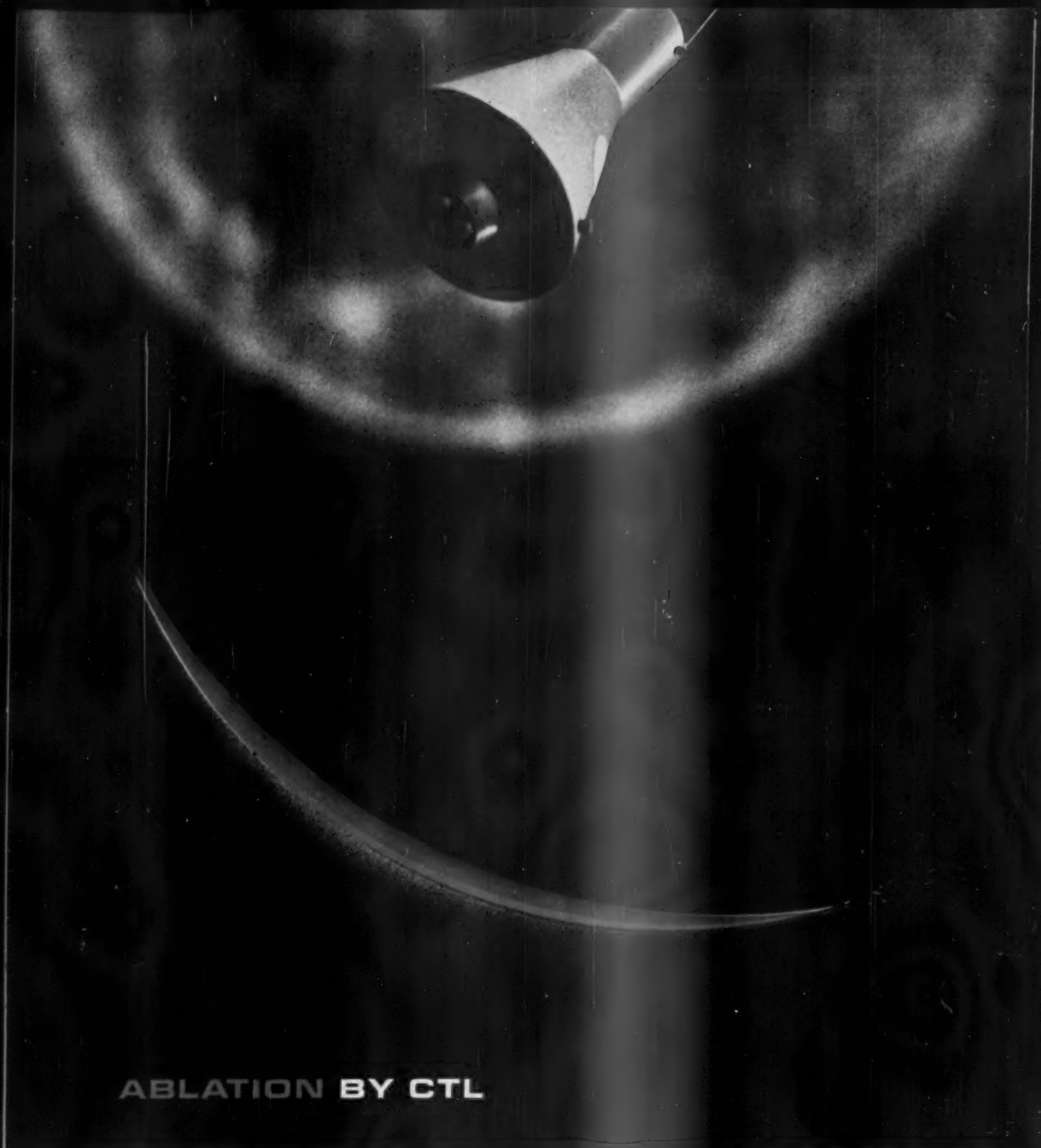
Missile and space equipment accounted for $103,000,000 of our total business of $689,692,312 in 1959. In addition to being the prime contractor for two important missiles, Talos and Eagle, we are also a supplier of components and sub-systems for most U. S. missiles. Bendix is likewise taking an active part in Project Mercury and in satellite communications. The first is the program to put a man into space. The second will mark a new era in communications by using a satellite in orbit as a relay station for global radio messages.

Bendix also has a growing and diversified nuclear program. Since 1949 we have operated the Kansas City Division for the Atomic Energy Commission. It is a large manufacturing organization employing 7,500 people engaged in the atomic weapons program. We also supplied control mechanisms for nuclear submarines and nuclear industrial power plants, and we are playing a part in developing the newest U. S. atomic power plants for aircraft, missiles and space vehicles.

Thus, as we drop "Aviation" from our corporate name, but not from our programs, we face a tomorrow where the range of our opportunities is broadening at a breathtaking rate.

A thousand <u>*diversified*</u> *products*

THE Bendix CORPORATION
Fisher Bldg., Detroit 2, Mich.



Heat dissipation by the gradual and controlled separation of matter—an area of intense research at CTL for several years. If heat flux on any surface in your design ranges from 50 btu/ft² sec to 50,000 btu/ft² sec, benefit from CTL's work with reinforced plastic fabrications. Development of high temperature resins plus sophisticated reinforcement fiber orientation has made it possible for CTL to provide effective, low-weight fabrication —expansion cones of Minuteman, the nose of the Jupiter, the face of the Mercury. Find out how CTL can assist with your heat insulation problems. Request Bulletin 160.

ctl CTL 1242 GLENDALE-MILFORD ROAD, CINCINNATI 15, OHIO
A Division of Studebaker-Packard Corporation

NEW THERMOPLASTIC RECORDING DISPLAY ACHIEVES

Detection to Projection in Less than a Second

Large-screen display of radar signals can be recorded and projected in less than a second. This advanced technique in information display is an example of one application of the new thermoplastic recording system developed by General Electric.

The grainless, thermoplastic film eliminates processing delays and permits, with higher resolution, much greater enlargement than is practical with high-speed photographic film. Target delineation is also significantly improved by optical filtering used to increase the signal-to-noise ratio.

Now undergoing final development in General Electric's Electronics Laboratory, the "thermoplastic display" is expected to find maximum application in the high-speed radar systems of the future. 176-03

Progress Is Our Most Important Product

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION
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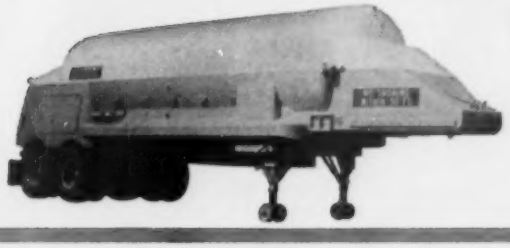
SYRACUSE, NEW YORK

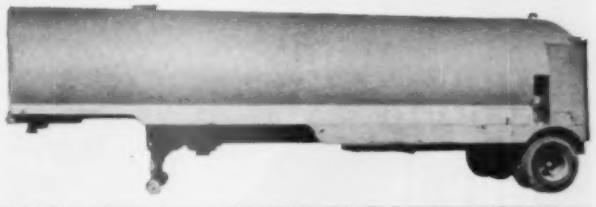
STANDARD
CAMBRIDGE

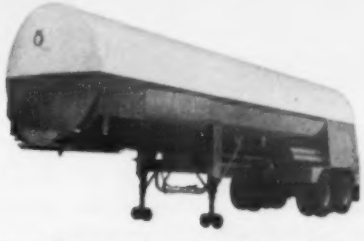
LIQUID OXYGEN AND HYDROGEN TRANSPORTS



Model 4100 M has been endurance tested over Belgian block and gravel roads, plus rugged cross country hauling. It has been environmentally tested at temperatures ranging from −65° F to 160° F. It has been subjected to salt spray, rain, fungus, sand and dust. Similar units are now in operational use by the military.

Transport problems usually associated with liquid hydrogen have been successfully solved by STANDARD trailers. Since mid-1957 these trailers have been used for deliveries more than 1000 miles distant. The illustrated unit has a capacity of 5400 gallons.





Model SA 4000 trailers have a stainless steel inner vessel in combination with an outer shell of lightweight aluminum to provide maximum payload. With a rated capacity of 3800 gallons, they are transporting liquid oxygen, nitrogen and argon in daily service.

Tested Environmentally – Proved in Use

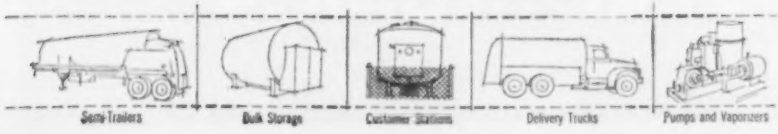
STANDARD has the fully integrated facilities to properly design, manufacture and test equipment for the transportation, handling and storage of cryogenic fluids. Three modern, fully equipped plants strategically located across the United States — in Massachusetts, Illinois and California—are staffed with men skilled in all phases of cryogenic practice. STANDARD'S 60,000 GPH test loop is typical of its facilities. Environmental rooms duplicate almost any condition of heat, cold, wet, wind, and contamination.

As one of the largest manufacturers of cryogenic trailers, STANDARD pioneered the first all-aluminum transport for liquid oxygen service. Similar units for military or commercial use are available using aluminum, stainless or carbon steels.

Send today for the new STANDARD Cryogenics Bulletin.

STANDARD STEEL CORPORATION

CAMBRIDGE DIVISION



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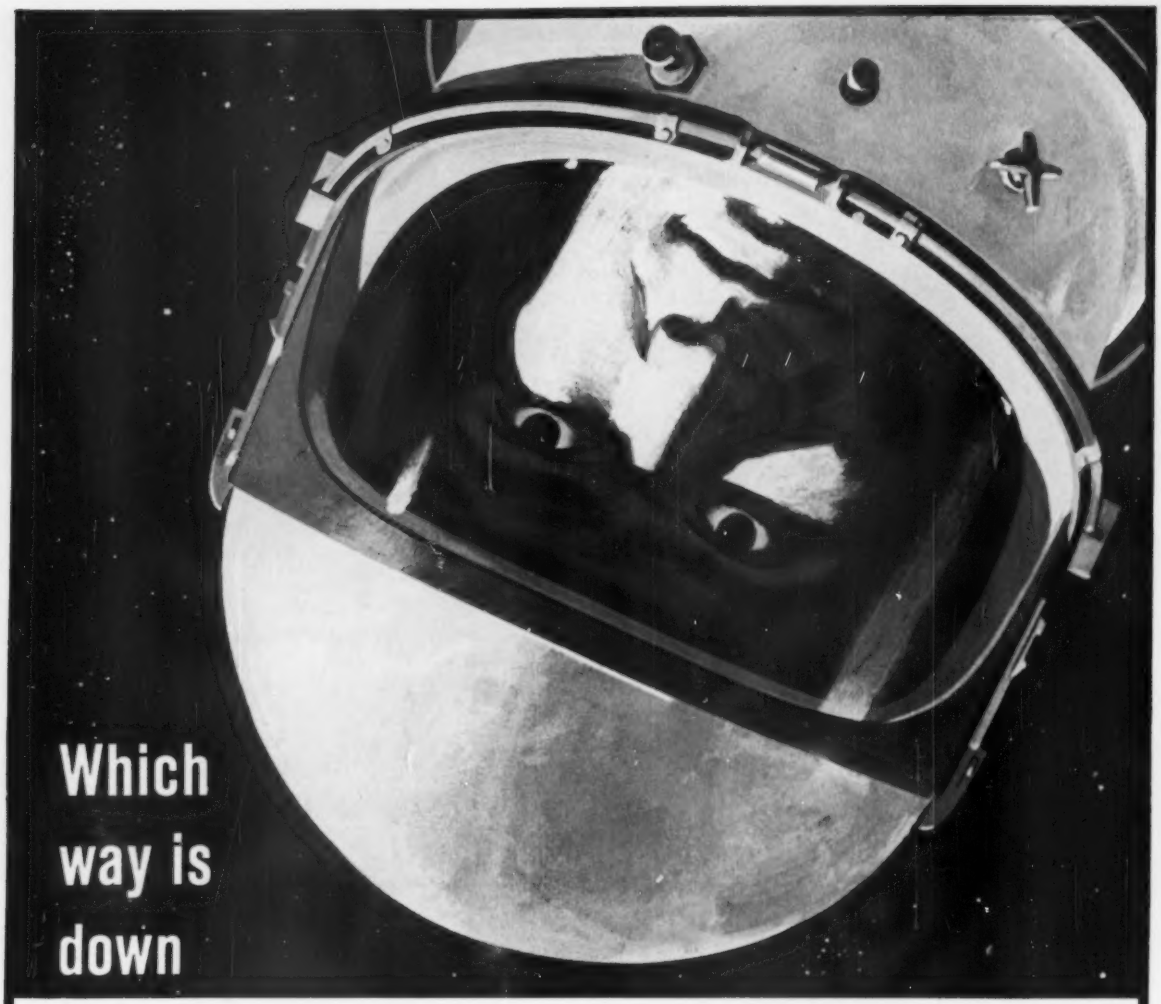

Which way is down in Space?

GUIDANCE IN SPACE for manned and unmanned vehicles is one of the most challenging projects underway at Ryan Electronics today. Through advanced research and development, Ryan Electronics is solving the problems of missile and space guidance systems.

Some of the areas being explored include rendezvous terminal guidance, anti-satellite guidance, space vehicle landing aids, satellite communications, and mid-course guidance.

Ryan Electronics is also studying applications of continuous-wave doppler techniques to the terminal phases of space missions.

Ryan Electronics is the pioneer and recognized leader in continuous-wave doppler navigation systems—the most advanced, proved means of aerial navigation yet developed for modern flight. Automatic Ryan navigators, in wide use throughout the world, guide all types of aircraft—ranging from helicopters and slow flying reconnaissance aircraft to high altitude supersonic jets.

Now, through a major research and development program, Ryan is working to provide the best guidance for America's ventures in Space tomorrow.

RYAN OFFERS CHALLENGING OPPORTUNITIES TO ENGINEERS

RYAN ELECTRONICS

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June 6, 1960

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COVER: Kiwi-A nonflying test reactor for Project Rover nuclear rocket program is photographed during full-power operation. Photo is enlargement made from a frame of a motion picture film taken about 500 yd. from the test cell. Hydrogen exhaust flame extends well beyond the luminous central column as indicated by blurred mountain background. See p. 102 for story and other photos on the Kiwi project.

PICTURE CREDITS

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83,250 copies of this issue printed

Another USAF missile
develops from a program
which is in itself a...

Titan, America's two-stage intercontinental ballistic missile, is making giant strides—attaining new goals in U.S. missile technology. It has repeatedly demonstrated its ability to accomplish stage separation and altitude start of the sustainer engine. Equally outstanding successes in guidance and nose cone ejection-recovery are making Titan a significant contribution to our national space potential; a highly sophisticated missile system powerful enough to deliver a warhead accurately at more than 5,500-mile range.

As Titan continues to develop toward a state of operational capability, it provides another demonstration of the remarkable successes of the U.S. Air Force's ballistic missile program. This program, conceived only six years ago, has produced progress beyond expectation in an undertaking never before equalled in complexity.

Space Technology Laboratories is responsible for over-all systems engineering and technical direction for Titan, as it has been for Thor, Atlas, Minuteman and related space programs. Principal associate contractors for Titan include: The Martin Company for airframe and system integration, Avco Manufacturing Corporation for nose cone, Bell Telephone Laboratories and Remington-Rand for guidance, Aerojet-General Corporation for propulsion.

Important positions in connection with these activities are now available at STL for scientists and engineers with outstanding capabilities. Inquiries and resumes are invited.

SPACE TECHNOLOGY LABORATORIES, INC.

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EDITORIAL

Military vs. Civil Space Requirements

When the United States belatedly developed a national requirement for a space exploration program, the decision was made to entrust this task to a civilian agency. Subsequently an Administration policy developed to scoff at the potential military uses of space technology and to stress the "peaceful" uses of space along with international scientific cooperation in space exploration.

It has become evident as space technology progressed that the most immediately effective use of space for genuinely peaceful purposes lies in the development of satellite reconnaissance and communications systems that will make surprise attack by a potential aggressor with ballistic missiles extremely difficult. Removing the element of surprise from an ICBM arsenal obviously subtracts one of its most potent military assets.

It has also become evident that the development of an operationally reliable reconnaissance and communications satellite system must travel a research, development, design and production road that diverges sharply from the requirements of purely scientific exploration of space.

It is this sharp difference between the requirements of an operationally reliable military satellite system and scientific space probes that is becoming increasingly obvious as the primary space technology requirements continue to be formulated from the scientific rather than the military viewpoint.

Military System Needs

First, a military space system must have a high degree of urgency spurring its development to become operationally effective in time to produce the required results. It must also have a far broader outlook in its design, development and production, aiming at a completely operational system, logistically supportable and capable of being manned with average rather than highly skilled scientific personnel. It must be designed not only for continuous operational reliability but also for a price that will fit into the national budget structure.

The biggest problem of a military space system is operational reliability. It must embody not just one or a few satellites but a complete system of satellites giving continuous, reliable global coverage and equipped with payloads that can function 24 hr. a day for periods up to six months or a year. Any malfunctions of these satellite systems must be capable of quick repair by a swift replacement with the precise launch and orbit required to fill the exact gap in the system. This requires a capability far more extensive and advanced than that necessary for scientific space probes.

A military space system requires substantial tracking facilities to monitor the steady function of the satellites and their payloads. It also requires the speediest continuous data reduction and transmission that the most advanced electronic computer techniques can provide. Swift warning of an enemy's aggressive action would serve no useful purpose if its data reduction and transmission did not reach responsible sources until after the first missile struck.

Booster Requirements

The requirement for relatively large quantities of military satellite boosters in comparison with those needed in scientific ventures and the requirement for short-notice launching to replace defective satellites in the system both point in the direction of a cheaper, more easily producible and more reliable booster than is now being developed for space exploration. Recovery of these boosters will also probably be dictated in the interests of reasonable costs.

Military space systems, once their research and development phase is past, will probably be larger and more complex to operate than the current liquid-fueled ballistic missile arsenal. Consequently, it will not be possible to develop all possible types of space systems at once with any degree of technical, financial or military feasibility.

What is needed now is a thorough re-examination of the military role in space with a view toward what it can contribute to the preservation of world peace in the immediate future through the reconnaissance and communications satellite systems. This should be followed closely by some immediate, selective decisions establishing top priority and a policy of concurrency in proceeding with both research and development and the other efforts required to produce all the elements of an operational system at the same time. While this is going on, it should be possible to take a longer look at what the next generation of military space possibilities can offer and begin to lay a solid foundation of research and development in that direction.

Space Potential

Sooner or later this nation must face the fact that there are basic technical and operational differences involved in the development of space boosters, vehicles and techniques for the scientific exploration of space and of those aimed at useful military requirements. Few people would take issue with the assignment of the scientific space exploration role to NASA.

But it is becoming increasingly evident that in the political emphasis on the civilian aspects of this program and its direction we are not recognizing the full military potential to be realized in the immediate future from space technology. We are, in fact, just beginning to recognize that it is a far, far different road we must travel to reach this goal in contrast to the valuable but distinctly different goal of scientific exploration of space.

—Robert Hotz

RECONNAISSANCE, THE LACK OF IT, AND A FAULTY COMMAND DECISION

The year is 1862. The Army of the Potomac, 70,000 men in blue, is primed to do battle. Facing them, General John B. Magruder's divisions of the Confederate Army of Northern Virginia firmly entrenched before Richmond, but numbering only 15,000. The sheer weight of Federal men and equipment apparently is sufficient to gain the victory, destroy the Southern force, capture the Confederate capital and perhaps end the war.

But General George B. McClellan, the Union Commander, never orders the advance. Why?

During the years preceding the war, adequate provisions for reconnaissance had not been made. McClellan's intelligence, directed by the famous detective Allan Pinkerton, overestimated the strength of the Confederate forces . . . *overestimated those forces to be twice those of the Army of the Potomac.* During this early phase of the War, Union reconnaissance cavalry is too inexperienced and limited in number to verify this civilian intelligence. And so this singular Union opportunity slowly ebbs—dissolving into three more years of bloody warfare . . . the result of a faulty command decision.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

CHICAGO AERIAL INDUSTRIES, INC.

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WHO'S WHERE

In the Front Office

Barnet R. Adelman, executive vice president, United Technology Corp., Palo Alto, Calif., a subsidiary of United Aircraft Corp. Mr. Adelman continues as director of the Operations Division. Also: **Newton V. Turney**, vice-president, was named treasurer.

Victor Koby, a director and general manager, Field Aviation Co., Ltd., Oshawa, Can.

Curtiss-Wright Corp., Wood-Ridge, N. J., has retained **Grover Loening** as consultant to evaluate the technical approach and marketability of the company's executive and transport VTOL model airplanes.

Kenneth H. Klipstein, a director, Daystrom, Inc., Murray Hill, N. J. Mr. Klipstein is executive vice president of American Cyanamid Co.

N. J. Holter and **R. F. Winters**, directors, Task Corp., Anaheim, Calif. Mr. Winters is Task's director of manufacturing; Mr. Holter is president and research director of Holter Research Foundation.

Henry J. Hirtzer, vice president, Donner Scientific Co., Concord, Calif.

Pacific Semiconductors, Inc., Culver City, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc., has elected the following as vice presidents: **Lawrence T. Lindgren**, for manufacturing; **Dr. John W. Peterson**, for research and development; **Sidney L. Spiegel**, for marketing.

L. D. Rexroat, vice president and director of marketing and a director, U. S. Science Corp., Los Angeles, Calif., a division of United Industrial Corp.

Homer F. Lewis, vice president and treasurer, Transval Electronics Corp., El Segundo, Calif.

Louis Polk, Jr., vice president of operations, the Sheffield Corp., Dayton, Ohio, a subsidiary of The Bendix Corp.

John H. Richardson, vice president-marketing, Hughes Aircraft Co., Culver City.

Presson S. SLane, vice president, Atlantic Research Corp., Alexandria, Va.

Edwin F. Shelley, a group officer and vice president, U. S. Industries, Inc., New York, N. Y.

Thomas C. Werbe, Jr., deputy assistant secretary of defense (supply and logistics), Department of Defense, Washington, D. C., succeeding **James P. Falvey**, resigned.

Honors and Elections

L. Berkley Davis, vice president of General Electric Co. and general manager of GE's electronic components facilities, has been elected president of the Electronic Industries Assn., Washington, D. C., succeeding **David R. Hull**, a vice president of Raytheon Co.

George L. DeMent, Chicago's commissioner of public works, has been elected president of the Airport Operators Council succeeding **John R. Wiley**, aviation director of the Port of New York Authority.

J. Y. McClure, manager of quality control at the Fort Worth plant of Convair Division of General Dynamics Corp., has been elected president of the American Society for Quality Control.

(Continued on page 124)

INDUSTRY OBSERVER

► Chance Vought's proposal for the Slam nuclear ramjet missile calls for a wingless configuration 70 to 80 ft. long and 10 ft. in outer diameter, with nose flaps for aerodynamic control. Reactor diameter is expected to be approximately 5 ft.

► **Republic RF-105 has been proposed as an interim Royal Air Force reconnaissance aircraft for use until the English Electric-Vickers TSR.2 tactical strike-reconnaissance aircraft is operational.**

► Chicago Aerial Industries has developed a compact aerial camera for low-level, high-speed photo reconnaissance missions. It uses a 4.5-in. square format instead of the current 9-in. square, and it has a cycling rate up to six exposures per second. Film is processed in flight at about three inches per second, is ready for interpretation immediately on return of a one-man aircraft from mission, or for interpretation during mission in the case of multi-manned aircraft.

► **New configuration of USAF-Douglas GAM-87A Skybolt air-launched ballistic missile eliminates canard controls, uses fixed nozzle and movable fins for first stage control, movable nozzles for second stage. Propulsion system also has undergone design changes. Missile, aircraft and other system components have been given the weapon system designation WS-638A.**

► Second attempt to put a 100-ft. Echo communications sphere into orbit, originally scheduled for next May from Pacific Missile Range, now may be substituted for the Tiros II meteorological satellite launching that had been scheduled for August from Atlantic Missile Range. First launching of Tiros, using a Thor-Able vehicle very similar to the Thor-Delta, was a success. First launching of Echo, using the first Thor-Delta vehicle, was a failure. Third launching of an Echo inflatable satellite was scheduled for January, 1962, under the original Delta timetable.

► **Jet Propulsion Laboratory's work on Army missile programs, including Sergeant and Corporal, is expected to be phased out after July 1. This will leave the laboratory, which is operated by California Institute of Technology for National Aeronautics and Space Administration, free to give full time to spacecraft and small amount of remaining space propulsion work.**

► NASA plans to make public the frequencies to be radiated from satellites and the telemetering codes being used in future launches whenever other observers around the world can usefully participate in experiments. Information will be distributed through the National Academy of Sciences and the Committee on Space Research (COSPAR) of the International Council of Scientific Unions.

► **Air Force Ballistic Missile Division is giving increasing consideration to use of "unwired" earth current for communication between Minuteman intercontinental ballistic missile silo control centers and command posts (AW May 18, 1959, p. 26). Relative invulnerability is system's most attractive factor.**

► JPL's Ranger space vehicle will have radio communication for midcourse guidance correction on lunar flights. Reaction jets will furnish attitude control needed for the solar panel power supply and the directional antenna that will be used for earth-vehicle communications.

► **Changes under consideration in the continuing reorganization of Air Research and Development Command include placing Hollywood, Calif., regional office under Ballistic Missile Division, the New York office under Command and Control Development Division and the Chicago regional office under Wright Air Development Division.**

► Communist China claims it is doubling the number of agricultural aircraft in use this year over last year. Its Civil Aviation Administration has sent aircraft to 11 provinces in central, east and northwest China since March to spray for wheat rust.

Why Offset Paper Masters by Xerography?

What's xerography?

A dry, clean, fast, electrostatic copying process that economically prepares offset paper masters for duplicating. You can enlarge, reduce, or copy size to size. Original may be anything written, printed, typed, or drawn. Equipment used is called XeroX® copying equipment, made by Haloid Xerox Inc.

Is XeroX copying equipment easy to operate?

Yes. Three simple steps: exposure, *dry* processing, and dry transfer. Within a few minutes anyone can learn the operation. No original is too hard to handle. There are no critical exposures or temperatures; therefore, waste of materials from wrong exposures is negligible—almost impossible.

How about quality?

Superb. Often it's hard to tell copies from the original. That's why many office-service and engineering-reproduction departments use XeroX copying equipment exclusively for the preparation daily of hundreds of offset paper masters.

Can a copy ever be better than the original?

Yes. Copies of dog-eared and cracked engineering drawings, carbons of bills of lading look far better than the originals when the masters are prepared by xerography.

What about costs?

Costs are surprisingly low. There are many reasons: xerographic materials cost only a few pennies per master. No special offset paper masters are required and none are wasted. Operator's time is lower because there are no critical adjustments for exposures. The more you need offset paper masters, the more you'll save by xerography over any other method.

No wet chemicals?

None whatever. No peel-apart either. And, of course, there's no changing of chemicals—no "KP" for an office girl at today's higher salaries.

How about length of runs?

You get much longer runs from masters prepared by xerography. Because of their durability, xerographic images do not break down from wet chemicals, thus last longer, and produce much lengthier runs—5,000 and 10,000 copies are not uncommon.

Do masters have to be "hardened" after preparation by xerography?

No. They are ready immediately for the duplicator and, unlike photographically prepared masters, they don't require remoistening to prevent fill-in if the machine stops during the run.

Any need of a darkroom?

None. XeroX copying equipment is operated in full roomlight.

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Washington Roundup

Missiles for Britain

Britain plans to use both the Skybolt and Polaris missiles as delivery systems for its own thermonuclear warheads. Details of the plan were discussed in Washington last week during the visit of Defense Minister Harold Watkinson.

British will contribute both money and technical personnel to the Skybolt research and development effort. The Douglas air-launched ballistic missile is expected to go into operation on part of the RAF Bomber Command Victor and Vulcan fleet in 1965. RAF will fly V-bombers to the U.S. for operational tests of Skybolt at Eglin AFB.

Royal Air Force will use the rocket-powered Vickers Blue Steel Mark I air-to-ground missile (see p. 109) on its Victor and Vulcan bombers until Skybolt is ready.

Polaris missiles are expected to go into submarine service with the Royal Navy in the 1967-68 period. U.S. will provide technical assistance to Britain for its own Polaris submarine building program. Any earlier British use of Polaris would depend on U.S. supplying the North Atlantic Treaty Organization with a mobile, land-based Polaris system.

British plan to use their own thermonuclear warheads on both the Skybolt and Polaris missiles.

Discontent over promotion policies may cost the Air Force many of its electronics officers. Many officers reaching their 20 year retirement option are unhappy over the policy of selecting general officers almost entirely from rated flying officers. This unhappiness is developing at a time when USAF's need for electronics specialists is growing.

Avionics companies have caught wind of the mounting discontent. They are actively recruiting colonels and lieutenant colonels with electronics background who are approaching retirement eligibility.

Nuclear aircraft program is under study by an ad hoc committee of the Air Force Scientific Advisory Board. Survey will be launched with a June 15 visit to Pratt & Whitney in Hartford, Conn. Group is headed by Ernest Plesset, chairman of the board's nuclear panel.

SAGE Rescue Effort

Efforts to save hardened SAGE super-combat centers from the budget are pegged to the argument that the centers could double as government command posts in a nuclear attack. Funds for eight of the underground centers were cut from the Fiscal 1961 budget. Supporters say any one of the super-combat centers, equipped with an AN/FSQ-7A digital computer, communications and display facilities, could be used to conduct the nation's military operations if other centers were destroyed in a nuclear attack.

Departure of Associate Administrator Richard E. Horner from NASA at the end of the month will mark the first in a series of changes in top echelons that will occur over the next half-year.

Administrator T. Keith Glennan is expected to stay in office until President Eisenhower leaves the White House in January. It is doubtful that he will stay beyond that point unless the next President makes a strong plea for his services.

Homer Joe Stewart, head of the NASA Office of Program Planning and Evaluation, set a two year limit when he accepted the job. He is expected to leave NASA headquarters late next fall to return to California Institute of Technology's Jet Propulsion Laboratory.

Air Force Col. Charles H. Roadman will join National Aeronautics and Space Administration soon as a special assistant to Clark Randt, director of the Office of Life Science programs. Roadman currently is chief of the human factors branch under the Deputy Chief of Staff for Development in USAF headquarters.

Wrapup

Senate Appropriations Subcommittee on the Armed Services meets this week to write its version of the Fiscal 1961 defense budget. . . . Defense Department is scheduled to have a report on the aircraft nuclear propulsion program, requested by House Appropriations Committee, completed by October. . . . Legislation establishing an Office of International Travel and Tourism has been approved by the Senate Commerce Committee and stands a good chance of enactment this session. . . . Defense Department has scheduled the annual Quantico meeting of its top level civilian and military officials for June 16-18. About 160 officials will discuss matters of common interest, exchange ideas during the sessions at the Marine Corps School, Quantico, Va. . . . House is expected to debate proposed changes in the National Space Act this week. Changes in patent policy will be the most controversial issue. **—Washington Staff**

U-2 Data Aided U. S. Military Planning

Gates says Defense got valuable Soviet information, Senate hears explanations of program and incident.

By Evert Clark

Washington—High-altitude reconnaissance flights of the Lockheed U-2 over Russia provided Defense Department with military planning information on "airfields, aircraft, missiles, missile testing and training, special weapons storage, submarine production, atomic production and aircraft deployments and things like these," Defense Secretary Thomas S. Gates, Jr. said last week.

Gates' testimony before the Senate Foreign Affairs Committee was the first detailed official acknowledgment of the great value of the reconnaissance accomplished by the U-2 since 1956.

Although the U-2 program was operated by the Central Intelligence Agency—with weather research by National Aeronautics and Space Administration and USAF's Air Weather Service offered as the ostensible reason for the flights—Gates said it is obvious that Defense was "the prime customer" for the information gathered, and "ours was the major interest."

Results of the flights have been "considered in formulating our military programs," Gates said.

The Senate committee took four days of secret testimony on the U-2 operations, the government's responses to Soviet claims that one had been shot down and the pilot captured on May 1, near Sverdlovsk, and the abortive summit conference in Paris on May 16.

After censoring by Central Intelligence Agency and State Department, parts of the testimony were made public, although none of the testimony by CIA Director Allen Dulles was released. The most heavily censored of the testimony which was released was that of Dr. Hugh L. Dryden, deputy administrator of NASA. Dryden was familiar with NASA's portion of the U-2 program dating back to the original involvement of the predecessor National Advisory Committee on Aeronautics four years ago.

Dryden Testimony

Committee Chairman Sen. William Fulbright (D.-Ark.) told reporters after Dryden testified that Dryden had had "long experience—I think he knew a good deal about what was going on."

Fulbright said it was "a rather dangerous undertaking" to have used NASA as a "cover" for espionage operations. Dryden's testimony made it clear that NASA was taking directions from CIA from a period shortly after the downing of the U-2 became known until May 7, when NASA was instructed to refer all further questions to the State Department.

The heavily censored Dryden testimony did not make clear, however, how many, if any, NASA officials knew in the preceding four years specifically what the U-2's basic mission was and which agency was directing the overall programs.

Secretary Gates also defended his ordering of a communications alert from Paris on the night of May 15, just before the summit conference was to begin and said he would do the same again under similar circumstances. He said the military services are always on some degree of alert, and at any particular time it is "merely a matter of moving the degree . . . up or down the scale."

When he ordered the alert, the U. S. already was aware that Soviet Premier Nikita Khrushchev was to demand apologies from the President for the U-2 incident the next day and that Khrushchev planned to wreck the conference, Gates said.

Precautionary Alert

"It was not an act that was either offensive or defensive in character," Gates told the committee. "It was a sound precautionary measure. It did not recall . . . personnel from leave. There was no move of forces involved.

"However, I want to emphasize that it did make certain that if subsequent developments made necessary a higher state of readiness, such action could be taken promptly and convincingly," Gates said.

"Under the circumstances, it seemed most prudent to me to increase the awareness of our unified commanders. Moreover, since commands and individuals concerned in the decision process, including the President, Secretary of State and myself were overseas, it was important to check out military communications."

Gates wanted "a quiet increase in command readiness, particularly with respect to communications" and "without public notice if possible." Some commands "went further . . . than I anticipated," however, and the alert became public knowledge. But the alert "was proper and absolutely essential," Gates said, "and in similar circumstances I would take exactly the same action."

The testimony revealed that Gates, Secretary of State Christian Herter and the President were aware that a program of flights was planned for approximately the period in which the summit meeting was scheduled. None of them objected to the series of flights, and there never was a discussion specifically of whether the flights should be suspended while the summit meeting was in progress, according to the testimony.

Cause for Suspension

Herter indicated that suspending flights because of one diplomatic consideration or another would have "debarred" flights during so many periods that few could have been made. Gates said he knew of no time when diplomatic or political reasons had caused suspension of a flight, including the time of Khrushchev's visit to the U. S.

Gates was briefed "on the preliminary results of the Apr. 9 [U-2] flight" some weeks before the May 1 incident, and at that time he "gave my approval" to CIA for the next program of flights, "one of which would be selected to be flown," he said.

Gates' answer to the question of whether U-2 flights were under Air Force control read this way: "No, sir. They were under control of the [deleted]." An earlier Gates' statement, released by the committee, said CIA was the operator. Other testimony indicated that neither the President nor the National Security Council, which is composed of the President, Vice President and key cabinet officers, generally knew of or approved specific flights. CIA planned groups of alternate flights and at least sometimes asked approval of these groups, but the pattern was that CIA served as the operating agency for an over-all program

New Defense Alert

Washington—Another defense communications alert and exercise began at 11 p.m. EDT last Wednesday and was scheduled to last several days. Defense Secretary Thomas S. Gates, Jr., said the Joint Chiefs of Staff had recommended more such alerts on a "no-notice" basis as a result of the one called last May 15, the night before the summit conference was to have begun in Paris.

that had the President's approval.

The U-2 program originally was recommended by the CIA director with the concurrence of the Defense and State Departments, Gates said. Loss of the U-2 program "has removed an important source of intelligence that has been a very successful program over the past," he said.

Russia knew of the flights before May 1, in Gates' opinion, but "I don't believe [Khrushchev] knew the exact type and character of the flights. All he know was that there were [deleted] aircraft high above his sky."

Chairman Fulbright has sought to determine whether President Eisenhower should have departed from all precedent and acknowledged responsibility for the U-2 flights once the U. S. finally abandoned its series of "cover" stories and partial cover stories. He also was attempting to determine how the various decisions between May 1 and May 16 were made, whether there was proper coordination between the agencies involved and the White House and what, if any, corrective actions can be taken by the government on the basis of lessons learned from the U-2 incident.

Herter, Undersecretary of State Douglas Dillon and other Administration officials viewed the U-2 incident largely as a "windfall" for a Soviet policy that probably had envisioned wrecking the summit conference even if the U-2 incident had not happened.

NASA's role in the handling of post-May 1 statements to the public was carefully explored with almost every witness. Dryden said he and NASA Administrator Keith Glennan were informed on May 2 "that a U-2 had been lost, without further detail." A considerable portion of testimony immediately following that statement was deleted.

NASA "felt the burden of answering questions because for four years the existence of this NASA weather flight program [using U-2s] had been known," Dryden said.

Subsequent to May 2, NASA asked how it should answer questions on the downing of the U-2, but Dryden did not say in released testimony who NASA asked. But at some time before May 5, the CIA began giving NASA all its instructions on how to respond to questions. CIA said the answers had been coordinated with State Department, but NASA had no direct dealings with State, Dryden said.

"We asked for information," Dryden said. "The operation was not ours. We had no knowledge of the operation itself. We said, 'how shall we reply to these questions? We realize the fact that you do not know very much about where this airplane is, whether the Russians have an airplane, whether they have the pilot. What do you want us to say in this interim period? Can you find out more about it?'"

CIA and NASA worked out "guidelines" for answering questions. This occurred before Khrushchev announced that the pilot was alive and the aircraft captured. NASA answered early questions, but at a National Security Council meeting held outside Washington on Thursday, May 5, a decision was made to have State answer all further questions, witnesses testified.

White House Press Secretary James Hagerty was not at the meeting but was at the site with the President. He told reporters that the President had ordered State and NASA to make an investigation and make the results public. NASA was not told of the decision taking it out of the communication channel, Dryden testified. So at 1:30 p.m. EDT, NASA held a press briefing. In addition to answering questions, NASA put the "guideline" answers into the form of a memorandum and released it to the press.

State Department witnesses spoke critically of this full disclosure of the details of the "cover" story, but Dryden testified that he could not draw much distinction between replying to questions verbally and putting the same answers onto a piece of paper. Dryden said NASA stuck carefully to the cover story until Saturday, May 7, when State told the space agency to make no further statements. This was just after the high-level decision to say that "as far as authorities were concerned in Washington, there was no authorization for such flights." Herter said this statement was "still partly cover." On the following Monday, May 9, the President decided after meeting with Defense, State, CIA and others to assume responsibility for the flights and make what Herter called "the full statement."

Large portions of the testimony concerning Hagerty's role in the events, and particularly his failure to tell NASA that it was not to make statements after about noon on May 7, were deleted. He had not been called as a witness late last week.

"So far," Dryden testified, "we have not had any adverse reactions on the part of people with whom we are cooperating abroad in space programs" as a result of involvement with the U-2. He also said NASA's position as an international weather-information gatherer had not been compromised "so far."

Dryden said there had been 200 weather flights of the U-2 since 1956 carrying NASA and Air Weather Service instruments and covering about 264,000 mi. Ninety per cent of flight time was above 40,000 ft. and 40% above 50,000 ft., he said.

Primary purpose was to gather air turbulence information important for gust loading considerations in the design of the Boeing 707, Douglas DC-8, Lockheed Electra and military planes that fly at very high altitudes, he said.

NASA had "no detailed knowledge of flight plans until after the fact and as a matter of record we obtain information needed to analyze data," he said.

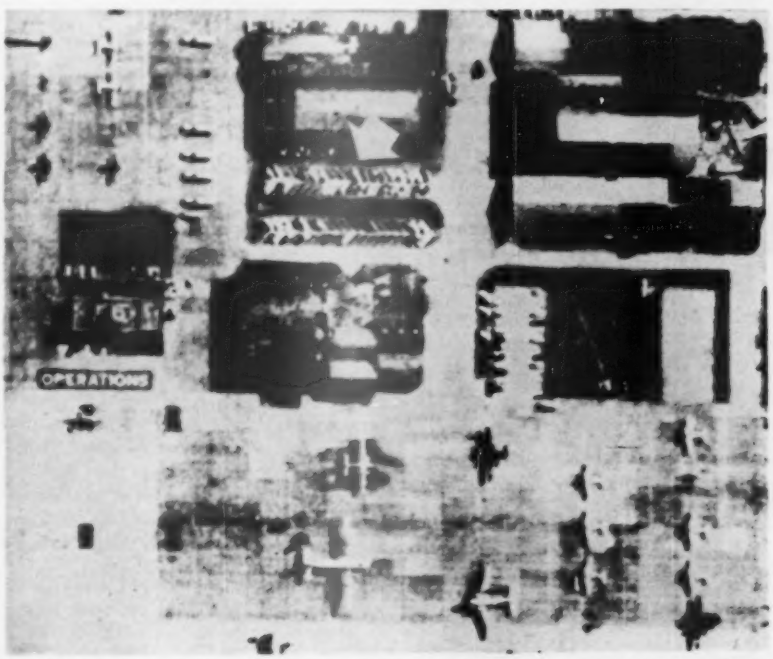


PHOTO taken by U-2 from 70,000 ft. over San Diego NAS, Calif., has high clarity. When outlined section (arrow) was enlarged, auto parking area markings were visible.

Soviets Boast of Impregnable Defenses

Washington — Central Intelligence Agency does not "have a plane with a ceiling that could not be reached by our rockets," Soviet Defense Minister Marshal Rodion Y. Malinovsky said last week.

In a Moscow speech, Malinovsky also backed up earlier warnings by Soviet Premier Nikita Khrushchev to countries that might allow U. S. aircraft to use their bases for flights over Russian or over any other Communist territory.

Malinovsky told a convention of Soviet "shock workers" that he had given orders to his chief of rocket forces, Marshal M. I. Nedelin, "to strike at any base from which a plane might fly to violate the territory of the Soviet Union or the socialist countries."

Russia has modern technical means "to determine quite precisely where the plane flies from, to watch over its flight and to determine where it lands," the defense minister said. "This means that no one will manage to escape responsibility."

"The action [retaliation against bases] would be fully justified," Malinovsky said, "because we do not know what the intruder plane may carry. It may well be a hydrogen bomb."

Soviet Defense Strength

Malinovsky took exception to Western statements that flights of Lockheed U-2 reconnaissance planes had proved that Soviet defenses were weak and that Russian anti-aircraft rockets could not reach above 60,000 ft.

"All of these unsuccessful attempts to cast doubts on our anti-aircraft defenses and at the same time to restore faith in the invulnerability of the Lockheed U-2 are very important to enlist new spies like [U-2 pilot Francis] Powers," the marshal said.

"Perhaps the gentlemen from the agency of Allen Dulles [Central Intelligence Agency] really do not know about the existence in the Soviet armed forces of an anti-aircraft potential, so I will tell them.

"Gentlemen, we have such rockets and we have wonderful rocket men. Our rockets are able to hit targets not only at an altitude of 20,000 meters [more than 60,000 ft.] but much higher," Malinovsky said.

"In short, you do not have a plane with a ceiling that could not be reached by our rockets. As you see gentlemen, sometimes we find it possible to bring some of our secrets into the open."

Two days earlier, Khrushchev told the same group that Soviet defenses once had been weaker. He said he had known of past flights and added:

"Now they say that the Soviet Union showed its weakness, meaning that in the past we could not bring down their planes. Yes, such a situation existed.

". . . Our fighters climbed that high but they couldn't find the aggressor planes and strike at them," Khrushchev said.

"In those days the government told its scientists, engineers and workers that the gap was to be filled and our skies should be swept clear of enemy planes. [They] did a good job to fulfill this assignment. They made up leeway, so to say, and produced wonderful missile techniques. And now it is the American militarists themselves who gave us this chance of demonstrating the full effectiveness of these missile techniques."

Khrushchev repeated his claim that the first missile fired hit the U-2 at 20,000 meters altitude, and said: "That was the last day spy planes could be sent into our skies with impunity."

U. S. "militarists" now are worried "because their entire military concept of attack on the Soviet Union, based on the use of bombers, crumbled away," Khrushchev said. "Indeed, modern bombers do not fly higher than 12,000 to 15,000 meters.

"This means . . . we shall certainly not let any bomber get through to its targets.

"Any of them will be shot down either by missiles or by fighters or by anti-aircraft guns which shoot that high," Khrushchev said.

Rocket Production

Russia has "stopped production of some kinds of rockets and cut down production of other kinds," Khrushchev said. "Rockets are not cucumbers. We can't eat them. You need only a certain number for defense."

In other developments resulting from the U-2 incident:

- **Soviet Foreign Minister** Andrei Gromyko, who presented Russia's unsuccessful case demanding United Nations Security Council condemnation of the U. S. for the May 1 flight of a U-2 over his country, said in New York as he departed for Moscow that Soviet armed forces have "a simple reply" for those "who like to reach into our house for such information—cut off such hands."
- **Norway's Foreign Minister** Halvard Lange told his parliament that no permits for reconnaissance flights by allied aircraft would be issued without special approval of the government. No permits have been given since May 1, he said. Defense Minister Nils Handal said a U-2 landed at Bodo, the field where pilot Powers was reportedly headed on May 1, in the summer or fall of 1958. Powers himself was in that area at about the same time, Handal said. He said there "is no reason to believe" the 1958 flight was "a question of anything but a normal flight," and he said it landed after normal clearance.
- **Khrushchev said** in a statement published in the government newspaper Izvestia that he had been prepared to meet with President Eisenhower privately in Paris before the summit conference, and that statements by Eisenhower and U. S. Secretary of State Christian Herter to the contrary "are incorrect." Since Russia was the "grossly injured" party because of the U-2 flight, the initiative for such a meeting was up to the U. S., but Eisenhower did not take that initiative, Khrushchev said.

New Soviet U-2 Story

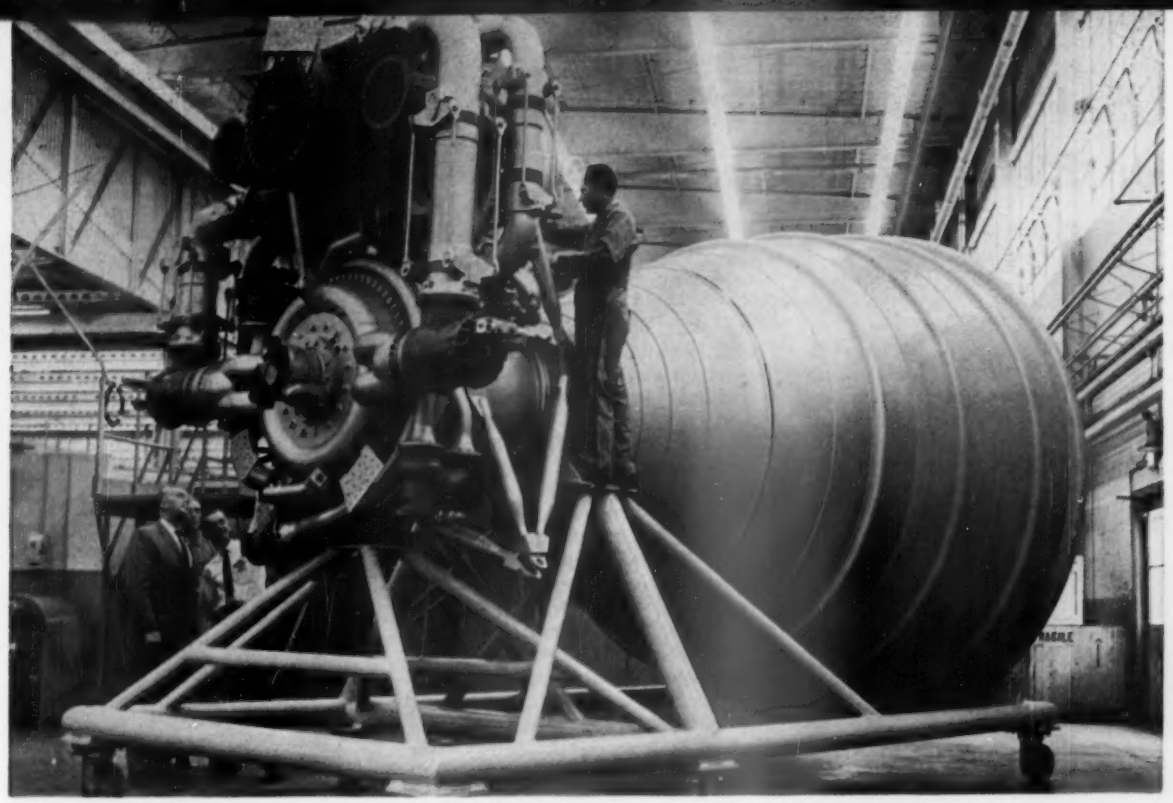
Moscow—Soviets now claim that the Lockheed U-2 lost near Sverdlovsk was made of titanium and as a result its structure was so light that it floated to earth from an altitude of over 60,000 ft. and landed without disintegrating completely.

This latest Russian explanation for the relatively good condition of the U-2 structure and equipment on exhibit in Gorki Park indicates also that the aircraft was not hit directly by a rocket but was sprayed by shrapnel from a warhead that exploded nearby.

Two previous accounts of the downing of the U-2 have been given by the Soviets. Premier Khrushchev said initially that the aircraft had been hit by a "remarkable" rocket. The description of the firing of this rocket given in Red Star, the Soviet army magazine, stated that the U-2 exploded when it was hit. First Russian pictures of the U-2 "wreckage" showed an aircraft that was almost completely disintegrated. These pictures were declared by U. S. experts to be fakes, and they bore no resemblance to the U-2 wreckage later exhibited in Moscow.

Second version of the U-2 interception and downing was circulated at this display of wreckage. It said that the rocket had hit the U-2 in its Pratt & Whitney J75-P-13 engine, and that this had prevented the pilot from being injured.

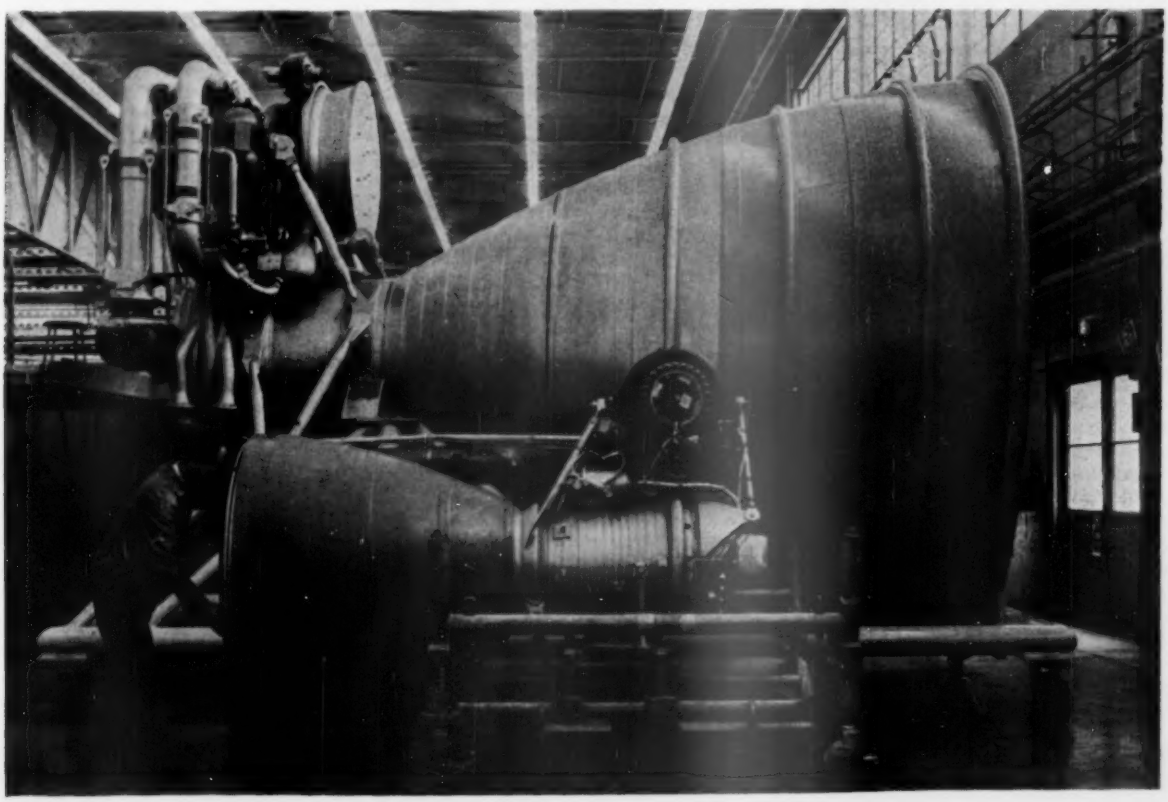
Examination of the U-2 wreckage in Gorki Park indicates that the pilot, Francis G. Powers, made an emergency belly landing in the aircraft (AW May 30, p. 32).



Mockup shows configuration and actual size of the F-1 1.5-million-lb. thrust rocket engine being developed by Rocketdyne Division of North American Aviation for National Aeronautics and Space Administration. Initial full-thrust tests of a complete F-1 engine are expected to begin next spring at the Rocket Engine Test Station at Edwards AFB, Calif. (AW May 23, p. 23).

F-1 to Be Tested at 1.5 Million lb. Thrust in Spring

Saturn H-1 engine in foreground is dwarfed by the F-1 mockup. A cluster of eight H-1 engines produced 1.3 million lb. thrust during an 8-sec. static test at Marshall Space Flight Center, Huntsville, Ala. Full-duration firing of this cluster would last 120 sec. and develop 1.5 million lb. thrust. NASA has proposed clusters of F-1 engines to obtain 6 million-12 million lb. thrust.



USAF Study Group Report Due On Electronic Support Systems

Bedford, Mass.—Report of the Air Force's Winter Study Group, which may recommend amalgamation of some of USAF's large electronic support systems, is scheduled for July.

Winter Study Group also is to recommend specific technical areas in the fields of automatic data processing, data sensors, display and communications which require development effort to meet Air Force needs in the 1965-70 period.

Electronic Needs

The Winter Study Group was formed six months ago to analyze the Air Force's projected needs for electronic support systems in the 1965-70 period and to determine whether there was needless duplication in the mushrooming numbers of such systems which Air Force has programed. This list includes the Strategic Air Command Control System (465-L), Air Force Control System (473-L), Intelligence Data Handling System (438-L), Electromagnetic Intelligence System (466-L) (AW Mar. 7, p. 229).

Under its charter, the Winter Study Group is authorized to determine what intelligence, command and control functions are required by USAF Headquarters, theater commanders and the Strategic, Air Defense and Tactical Air Commands, then recommend the best way to meet these needs with minimum investment and duplication.

Headed by Gordon N. Thayer of American Telephone & Telegraph Corp., with Lt. Col. John L. Lombardo, USAF Command and Control Development Division, and John F. Jacobs, Mitre Corp., as executive directors, the group now has 119 full-time members. Majority of the personnel are drawn from Air Force centers, Lincoln Laboratories, and Mitre Corp., with a few technical experts on loan from industry.

In addition to four system design panels which are analyzing user requirements, the Winter Study Group has established 13 specialty panels. Each of these specialty panels is studying a specific technical area or factor to determine whether the state-of-the-art can meet the demands of the proposed systems by 1965 and to pinpoint specific areas which need more development effort.

Panel Subjects

Specialty panels now encompass data processing, sensing equipment (such as radar, infrared), communications equipment, human factors, display, computer logic concepts, logistics, cost, vulnerability, design methodology, weapons, nature of the threat, and special studies.

Each of the four system design panels, after detailed talks with user commands, will come up with its own recommended system design which will then be compared with the design approach being employed in support systems now under development to determine whether the best approach is being used.

The four system design panels are slated to present their recommendations to USAF headquarters and the operating commands in oral presentations later this month to get their reactions and ideas before writing final panel reports.

Each of the 13 specialty panels is expected to issue its own report, indicating areas where the state-of-the-art is not sufficiently advanced to enable projected systems to become operational and effective in the 1965-70 time period. Each panel also will recommend specific research and development effort which it believes the Air Research and Development Command should fund to advance the state-of-the-art required for support systems.

Reports by the 13 specialty panels may be released to industry before the reports by the four systems design panels, according to present plans, so industry can learn where it should direct its research and development effort.

Tiros Spin Rate

Washington—Tiros I weather satellite, which is returning pictures of the earth's cloud cover from both high and low resolution cameras two months after launching, has had its spin rate increased to ensure stability.

One of two pairs of Atlantic Research Corp. spin rockets attached to the satellite's base was ignited May 27 from the Army Signal Corps ground station at Ft. Monmouth, N. J., as Tiros made its 819th circuit. Spin rate, which was slowed from 136 rpm. to 12 rpm. shortly after launching, had decayed to 9.4 rpm. Since about 9 rpm. is a critical minimum speed for stabilization, the rockets were fired in an attempt to spin it up to 12 rpm. Actual rate achieved by the firing was 12.85 rpm.

A circuit between Tiros' high resolution camera and the recorder that stored its information failed one day after launching on Apr. 1. But National Aeronautics and Space Administration said that on May 11, the circuit cleared, and Tiros has been able to store and relay high resolution pictures since then. Radio Corp. of America, which developed most of the satellite's instrumentation, has speculated that internal temperature was responsible for the failure and later operation of the circuit.

British, French Weigh VTOL Collaboration

London—Britain has agreed in principle to promote collaboration with France on VTOL aircraft, Minister of Aviation Duncan Sandys said in Parliament.

"The Hawker P1127 is designed to meet a probable military requirement and is, therefore, receiving first attention," said Sandys, but the potentialities of the Short SC.1, are also being jointly studied, although "for any practical use of this aircraft, we should need a new design of the aircraft itself and a new engine."

A Ministry of Aviation spokesman said talks between Britain, France and Germany had taken place only at the minister level so far, but would very shortly be continued by technical representatives. He refused to comment on Sandys' implication that Hawker VTOL knowledge obtained with the P1127 would be shared with the French as soon as any agreement is signed.

Soviet Space Cabin Operates in New Orbit

Washington—Pressurized cabin of Sputnik IV, which went into a higher orbit than its original one when an apparent attempt to re-enter it failed (AW May 30, p. 35), was still maintaining conditions suitable for supporting human life last week, according to Russian statements.

U. S. stations now are tracking eight

Earth Current Networks

Boeing Airplane Co. is conducting tests near Kent, Wash., on use of earth currents for weapon system communication networks. Concept involves transmission of subsurface electromagnetic waves for "unwired" communications between control points. Extensive experimental work in this field already has been done by Space Electronics Corp., Glendale, Calif. (AW May 18, 1959, p. 26). Space Electronics also is working on a $130,000 contract from Rome Air Development Center for experimentation and development in field of long-range communications using earth currents. The new contract deals with longer ranges than previous work.

pieces in orbit in addition to the final stage of the launching rocket. The parade takes 31.30 sec. to pass over a single tracking station.

Scientist V. Parin wrote in Izvestia that "an essential" before manned space flight is attempted "is continuous and thorough surveillance of all functions of animals coming back to earth after a long stay on artificial satellites." Other statements said control of spaceships must also be perfected.

Following is orbital information on the pieces now in orbit, according to National Space Surveillance Control Center. Epsilon I, the largest of the eight that are traveling roughly in a group and the only piece that is transmitting radio signals, is assumed to be the pressurized cabin. Epsilon II is the rocket body, still in approximately its original orbit.

Epsilon V last week was leading the group of eight pieces.

Epsilon I—apogee 415 mi., perigee 181 mi., period 94.3 min. Epsilon II—apogee 198, perigee 188, period 90.1. Epsilon III—apogee 414, perigee 172, period 94.3. Epsilon IV—apogee 426, perigee 176, period 94.3. Epsilon V—apogee 408, perigee 179, period 94.4. Epsilon VI—apogee 411, perigee 177, period 94.4. Epsilon VII—apogee 431, perigee 155, period 94.5. Epsilon VIII—apogee 412, perigee 180, period 94.5. Epsilon IX—apogee 435, perigee 175, period 94.5.

Suborbital Echo Shot Tests Radio Beacons

Washington—Tracking beacons were tested for the first time on a 100 ft. inflatable sphere last week in a suborbital flight of the Project Echo communications satellite.

National Aeronautics and Space Administration launched the sphere from Wallops Station, Va., and the two-stage, solid propellant Shot Put launch vehicle boosted the sphere to an altitude of about 210 mi.

It flew about 540 mi. eastward across the Atlantic Ocean.

The 100 ft. sphere, which was inflated in flight, carried two beacons imbedded in pads of Mylar plastic and cemented to opposite sides. Developed by Astro-Electronic Products Division of Radio Corp. of America, the beacon wafers were 10 in. in diameter and ¼ in. thick, and they weighed 11 oz. each. One beacon transmitted on 107.94 mc. and the other on 107.97 mc. They had a power of about 5 milliwatts, and they were powered by solar cells which charged nickel-cadmium batteries.

A small whip antenna was carried in a spiral groove in each beacon, and the antennas extended when the balloon inflated.

Midas Infrared Measurements Cut Short by Telemetry Failure

Washington—An Air Force-Lockheed Midas early warning satellite made measurements in several different sections of the infrared spectrum during its first 16 earth orbits before its telemetry failed and made it impossible to complete the test program and monitor an ICBM firing with an orbiting infrared sensor.

Major test objective with Midas II was to provide design data for infrared sensors to be used in operational satellites planned to warn of enemy ballistic missile attack.

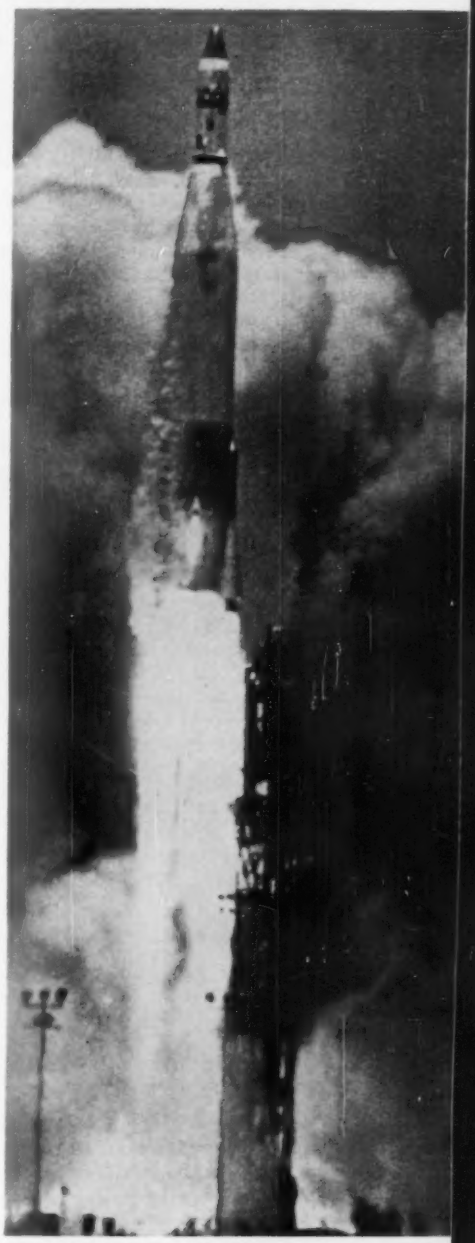
Data returned by Midas II was obtained in several sections of the infrared spectrum by using a series of filters to adjust the sensitivity of its infrared sensor. Measurements of background infrared radiation from many types of heat sources on the earth by Midas II were scheduled to precede the monitoring of an Air Force-Martin Titan ICBM firing from Cape Canaveral, Fla. This developmental firing of the Titan was successful and on schedule, but the Midas II command data link was inoperative.

Another portion of the Midas II test program that was not completed was measurement of infrared radiation from large sodium flares. These flares were scheduled to have been burned on the ground at Edwards AFB and Vandenberg AFB as the satellite passed overhead. They would have been visible 50 to 100 mi. in the desert and would have burned 45 sec. Sodium flares probably were included in the test program to provide a source of infrared radiation of known intensity on the ground to calibrate and check the equipment in the Midas II satellite.

Much of the high altitude data on infrared radiation from the earth has been gathered with Lockheed U-2 aircraft operated by Air Research and Development Command units from Edwards AFB. These U-2s have been used to monitor ballistic missile flights from Cape Canaveral, as well as to measure background radiation in many areas. Midas II was intended to extend the detailed infrared data up to altitudes of about 300 mi. The satellite's orbit was almost circular, with a 322 mi. apogee and a perigee of 292 mi.

Stabilization system in the Lockheed Agena second stage of the launch vehicle, which is an integral part of the Midas II satellite, functioned well and kept the infrared sensor properly oriented toward the ground during the first 16 orbits. USAF-Convair Atlas was first stage booster for Midas.

Midas and Samos launch complex at Naval Missile Facility, Pt. Arguello, Calif. has been completed and turned over to BMD. The Pacific Missile Range launch complex consists of two Atlas pads, with gantries, a blockhouse and ground support facilities. The $6 million installation was built by Wells-Benz, Inc., prime contractor to Navy Bureau of Yards and Docks.



FIRST SUCCESSFUL Midas launching is carried out at Cape Canaveral. Convair Atlas ICBM is booster, Lockheed Agena second stage carries infrared reconnaissance package.

Chance Vought to Build Airframes, Support Gear for USAF TS-609A

Dallas—Chance Vought Aircraft was awarded a $1.7 million contract last week to build the airframe and special support equipment for TS-609A, the Air Force version of National Aeronautics and Space Administration's solid propellant Scout launch vehicle.

Vought Astronautics Division will build airframe units for the first three stages of TS-609A, including transition sections which connect the rocket motors, stage separation devices, control surfaces and jet vanes, ignition and destruct systems and wiring packages. Company also will supply some ground equipment. Vought is airframe contractor for all four stages of the NASA Scout.

Air Force Ballistic Missile Division will launch TS-609A from Atlantic Missile Range to study ballistic missile re-entry problems and techniques, to test large scale models of such space vehicles as the Dyna-Soar glider and to launch various other research and development payloads. The rocket will be able to send a 100 lb. payload to an altitude of 7,000 mi.

Aeronutronics Division of Ford Motor Co. has an Air Force contract to design and develop payload carriers and integrate experiments into the payload carriers for TS-609A launches. Aeronutronics also has systems engineering and integration responsibilities for the USAF vehicles and is in charge of drawing specifications for any modifications ordered by the Air Force. Company will be responsible for assembly, checkout and launch of the TS-609A vehicles at AMR.

Air Force and Aeronutronics plan to use a variety of combinations of the four solid propellant engines available in the basic four-stage Scout vehicle. USAF apparently will use two and three stage vehicles along with the four-stage version. Engines in these combinations will be the first stage Aerojet Senior, second stage Thiokol Castor, third stage Hercules-Allegany Ballistics Laboratory X-254 and fourth stage Hercules-ABL X-248.

Standard payload carriers will be used in all the configurations, and a standard experiment package recovery unit has also been developed. A standard intelligence unit, to be carried on all flights, will also reduce need for modifications to the TS-609A vehicle. Unit will include guidance equipment, multi-channel telemetry unit, tracking beacon and full complement of vehicle test instrumentation. As with the NASA Scout, TS-609A will have a Minneapolis-Honeywell guidance system.

Air Force and Aeronutronics are scheduled to launch a TS-609A from AMR before the end of the year. NASA has attempted one Scout launch using live engines only in the first and third stages. Third stage engine failed to ignite. Apparently NASA will not repeat this launch, but plans to go ahead with a full four stage test launch sometime this summer.

Data Systems Directorate

Dayton—Air Materiel Command has established a new Directorate of Data Systems at AMC headquarters here, which will be responsible for development and implementation of standard materiel data systems for the Air Force and for logistics management data systems within the AMC. New directorate, headed by Brig. Gen. Francis C. Gideon, will provide single point of contact for Air Force contractors on problems involving processing and transmitting information between AMC and its contractors, as well as for automatic data processing equipment manufacturers. AMC now employs 18 large, 10 medium and 29 small computers at its various facilities.

United Wins Contract For Segmented Engine

Sunnyvale, Calif.—United Technology Corp. is working under contract from National Aeronautics and Space Administration to demonstrate feasibility of conical-shaped, segmented, solid-propellant rocket engines. Contract calls for design, fabrication and testing of three experimental engines with the program to be carried out this year at United's new facilities now being constructed here and at San Jose, Calif.

Hardware for the engines will be fabricated by Pratt & Whitney Aircraft Division of United Aircraft Corp., of which United Technology is a subsidiary.

United Technology previously had invented an economical method of designing, manufacturing solid propellant rocket engines of varying large sizes, a process which makes use of rocket-building segments of special design.

Small-scale rocket motors of the new type already have been designed, fabricated and tested with excellent results as part of an in-house research and development program, according to Barnet R. Adelman, United Technology executive vice president.

X-15 Control System

First airborne checkout of the North American Aviation X-15's ballistic control system was accomplished on the ninth powered flight of the number two aircraft, sixteenth powered flight in the series.

Reaction control system "operated well" at 50,000 ft. altitude at a speed of Mach 2 with pilot Scott Crossfield at the controls, although the system actually is not needed much below 100,000 ft. Designed for out-of-atmosphere portions of the X-15 research program, the hydrogen peroxide powered jets are located in the nose and wing tips for attitude control and develop from 40 to 110 lb. of thrust. The 9 min. flight, including 4 min. under rocket power, also furthered stability and control investigations.

Rocket Engine Award Given to Rocketdyne

Washington — National Aeronautics and Space Administration chose Rocketdyne Division of North American Aviation last week to develop a 200,000 lb. thrust liquid hydrogen rocket engine to power the Saturn S-II and S-III stages.

Rocketdyne was chosen from a field of five original bidders in the competition, which closed Mar. 14 (AW Feb. 15, p. 34). The company estimates that the three year engine development program will cost $44 million.

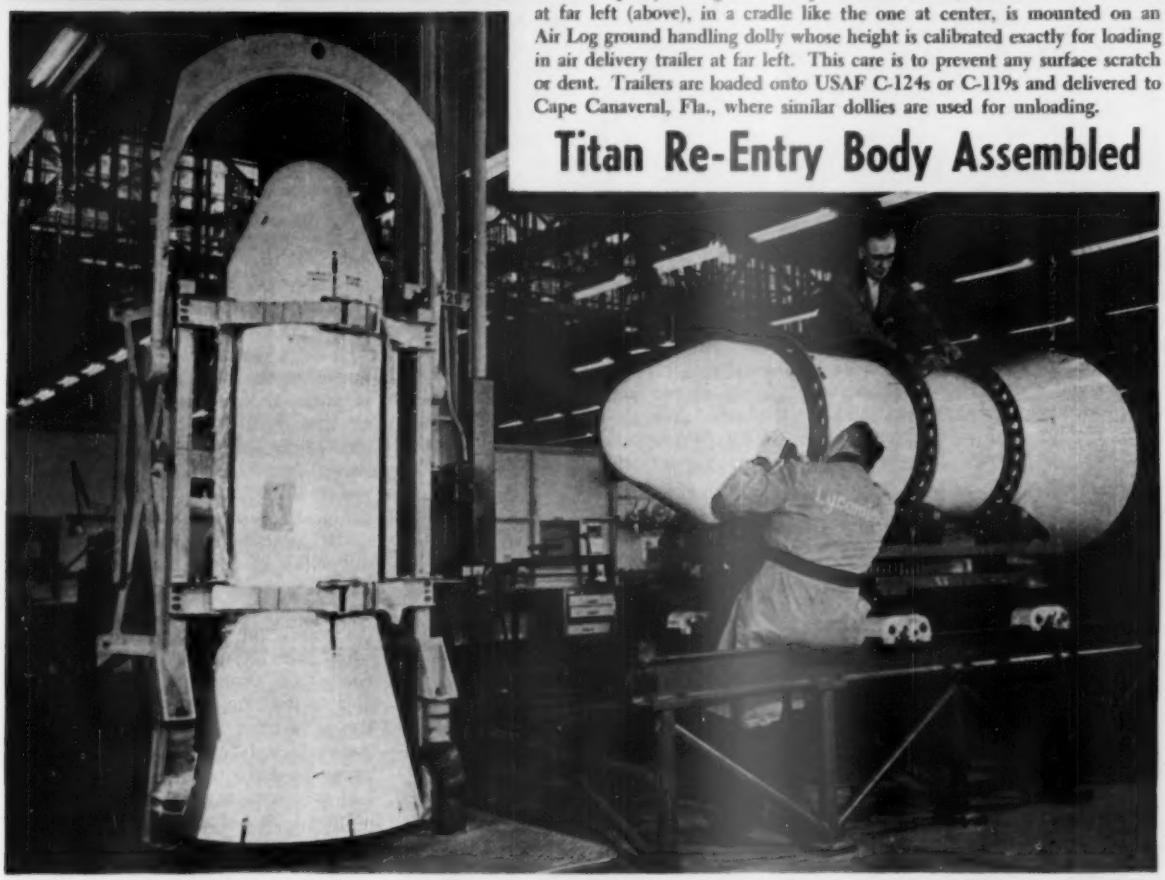
Liquid hydrogen-fueled Rocketdyne engine will be used in upper stages for later versions of the Saturn launch vehicle. Two engines will be clustered in the S-III stage, and later four engines will be used in the S-II stage. First version of the Saturn vehicle will have two 20,000 lb. thrust Pratt & Whitney XLR115 hydrogen engines in S-V, the third stage, and four of these engines in the S-IV second stage.

Stages with the Rocketdyne engine will be added later to increase payload capability. Saturn vehicle with a second stage powered by two of these engines will have a lifting capability 50% greater than the initial Saturn vehicle, and adding a second stage with four 200,000 lb. thrust engines will increase payload capacity nearly 100%.

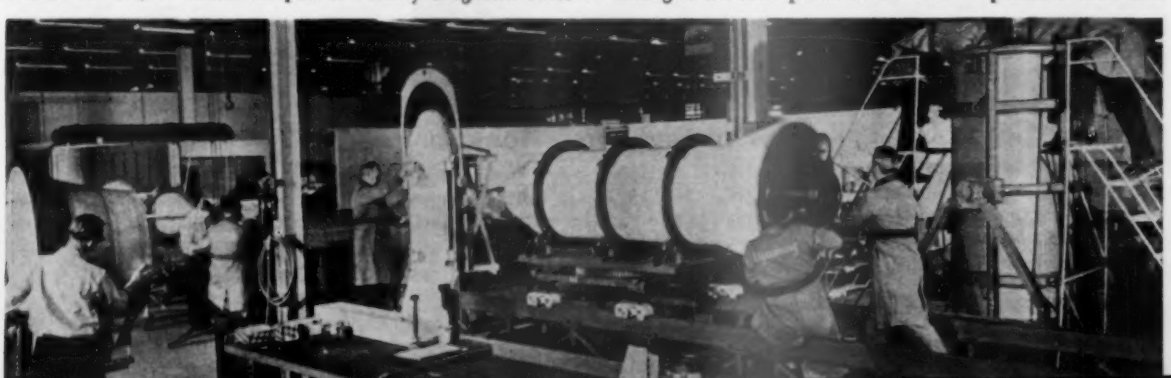
Although the engine is to have an eventual potential of 200,000 lb. thrust, Rocketdyne will be required only to meet a 165,000 lb. rating at the end of the three year development period. The hydrogen powerplant will be a single chamber engine with an initial single start capability. It is to be readily adaptable to later conversion to a multiple start system.

First photos of Titan re-entry vehicle production show final assembly at Avco Corp. Lycoming Division plant at Stratford, Conn. RVX-3 vehicle at far left (above), in a cradle like the one at center, is mounted on an Air Log ground handling dolly whose height is calibrated exactly for loading in air delivery trailer at far left. This care is to prevent any surface scratch or dent. Trailers are loaded onto USAF C-124s or C-119s and delivered to Cape Canaveral, Fla., where similar dollies are used for unloading.

Titan Re-Entry Body Assembled



Technician inspects an RVX-4 vehicle sensor with a magnifying glass (above) as another tightens the assembly cradle, mounted on a 360 deg. turntable. Cradle holding RVX-3 at left has provision for hoist attachment in the yoke and is used in mating the vehicle to the booster. Yoke rotates through 90 deg. at vehicle's center of gravity. Flare section of a more advanced vehicle (extreme left, below) is prepared for mating to the cylinder section. Third section into which the vehicle is divided is the nose section. Rear view of RVX-4 vehicle shows data cassette, the white spot on the circumference of the flare, and the conical section containing the recovery equipment, including telemetry antenna, shark repellent and a balloon. Container at right is handling equipment for installation of components in the cylinder section. RVX-3, -4 vehicles are part of a family designated Series IV leading to the development of the Mk. IV operational nose cone.



Defense Opposes Bill to Tighten Incentive Contracting Practices

By Katherine Johnsen

Washington—Department of Defense strongly opposed legislation which would ban incentive payments on its contracts unless the manufacturer can "completely demonstrate" that he has earned them. Opposition was expressed at hearings last week before the House Armed Services Committee.

The legislation, which also has provisions aimed at increasing the use of advertised bid contracting and at increasing competition in negotiated contracting, is sponsored by Rep. Carl Vinson (D.-Ga.), chairman of the committee (AW May 16, p. 125). It was drafted by the General Accounting Office.

The bill is a byproduct of hearings last year on extension of the renegotiation law, during which the aerospace industry and Department of Defense urged an amendment that would have exempted incentive earnings under incentive-type contracts—widely used by Air Force and Navy in missile and aircraft procurement—from the regular renegotiation process. Vinson charged at the time that the objective of the industry was excessive profits, and he succeeded in having the renegotiation law extended without significant change for three years, to June 30, 1962.

The Vinson legislative proposal on incentive payments is that "no contract negotiated . . . shall contain a profit formula or price redetermination provision that would allow the contractor increased fees or profits for cost reductions or target cost underruns resulting from causes other than those which the contractor can clearly and completely demonstrate are due to his skill, efficiency, or ingenuity in the performance of such contract."

Vinson's conviction—and also that of GAO and the Renegotiation Board—is that the contractor "savings" under incentive-type contracts for the most part have been due to cost over-estimates when the target price was established. Army has used price redetermination contracts in its missile procurement, instead of the fixed-price incentive type, on the grounds that the real savings from contractor efficiency or ingenuity can only be determined and rewarded following actual production experience.

Assistant Secretary of Defense for Supply and Logistics Perkins McGuire told the Armed Services Committee that the effect of the Vinson proposal hitting at incentive contracts would be "to force the Department to enter into more and more cost-plus-a-fixed-fee contracts" which are "frequently the most costly and inefficient types of contracts. . . ."

In seeking cost reductions, McGuire said, "we want all possible reductions and not just 'those which the contractor can clearly and completely demonstrate are due to his skill, efficiency, or ingenuity.' If we limit our sharing of cost reductions to those as to which such proof is possible, many other cost reductions would never be made because there would be no incentive for the contractor to make them." He suggested that there would be "a positive incentive" not to make cost reductions —so the contractor could keep his profits high, and keep both costs and profits high on follow-on contracts.

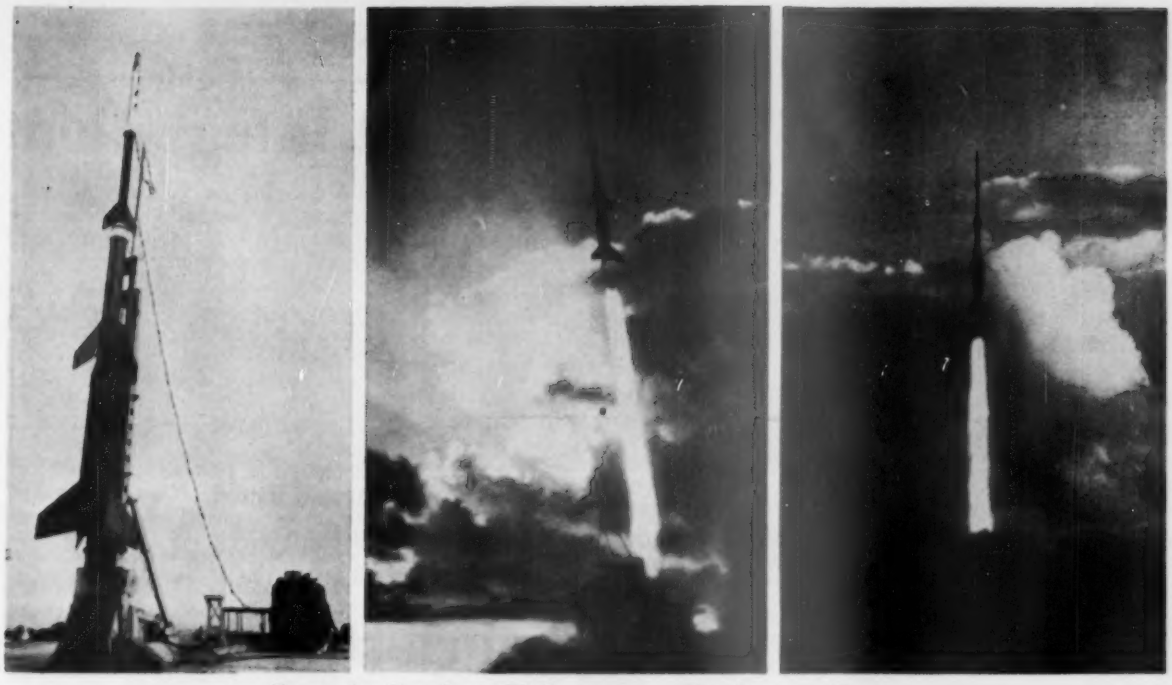
Experience with incentive type contracts, McGuire argued, "has demonstrated to us that it is much more important in dollars to the government to assure that all potential savings . . . be made, with as much as 80% of such savings reverting to the government, than it is to discourage any part of such savings simply because they were not demonstrably 'earned.'"

McGuire noted the administrative difficulties involved in determining cost savings actually "earned" by a contractor. As an example, he pointed out that it would be difficult to determine whether reductions in the price of subcontracted components were attributable to the efficiency of the subcontractor or whether they had been brought about through skillful purchasing by the prime contractor. Decisions as to who had "earned" what amount, McGuire observed, would be controversial and cause disputes, delays, and increased administrative costs.

McGuire also opposed a provision of the Vinson legislation which would require that a decision to enter a cost contract, cost-plus-fixed-fee, or incentive contract be made at the Defense and service secretary level on the grounds that it would impose a "serious burden" on the secretaries. At present, this authority is delegated to contracting personnel under regulations providing detailed guidance as to when these types of contract can be used. McGuire pointed out that only the contracting officer is familiar with the specific details of a negotiation, and said that "to require further approval by the secretaries of each individual contract appears to be both unnecessary and totally impractical administratively."

Marine Corps GV-1 Tanker Makes First Hookup

Grumman F9F Navy jet is refueled by Lockheed GV-1 turboprop tanker in first actual hookup of the new U. S. Marine Corps tanker version of the C-130 to a jet fighter. Drogues can be extended from pods under both wings of the plane to enable simultaneous refueling of two jets. New tanker goes into service this year and carries a total of 10,560 gal. of jet fuel, transferred at 300 gpm. Photo was taken from USAF C-130B.



French Rocket Telemeters Re-Entry Data

French four-stage research rocket which was fired last month from the Ile du Levant was designed to yield data on ballistic missile re-entry. First and third stages were made by SEPR rocket company. Second stage was built by French navy. Final stage was made by Office National d'Etudes et de Recherches Aeronautique, which conducted firing and programing for Sud Aviation, which has major responsibility in the French IRBM program. This first flight of the 40-ft. rocket lasted 6 min. 15 sec. First stage delivered 44,080 lb. thrust for 5 sec. before separating at 4,900 ft. Second stage delivered 4,408 lb. thrust for 32 sec. and separated at 75,000 ft. Third stage delivered 7,714 lb. thrust for 4.6 sec. and carried missile to about 90 mi. altitude at 3,500 mph. Third stage separated during descent when fourth stage ignited and accelerated missile to maximum descent speed of 5,000 mph. at about 15 mi. altitude. Nose cone instrumentation included telemetry transmitter with 41 information channels.

News Digest

Kaman H-43B has been cleared for operation as soon as alteration kits are installed. Helicopter was grounded May 9 because rotor blades struck the vertical tail during certain unusual flight conditions. Top 10 in. of the aluminum tail will be replaced with a light plastic material that will not damage rotors if they strike it. Alteration of the 23 H-43Bs delivered so far is expected to take two weeks.

Indian technical delegation is scheduled to visit Sikorsky Aircraft this week during a U.S. tour which is part of a continuing study of turbine-powered helicopters. India needs the machine primarily to transport and supply troops in the Himalaya mountains along the border with China. Indian government is studying both U.S. and British types. Sikorsky Aircraft licensed Japan's Mitsubishi Heavy Industries, Ltd., to produce and sell the twin-turbine S-61 in Japan and other Asian countries. Japanese are considering both military and civil use of the helicopter.

Air Force-Martin Titan carried an operational Avco Mark IV nose cone on its fifth 5,000 mi. flight down the Atlantic Missile Range. SAC officer ran the countdown for the first time on this flight, which was reported to be the 12th successful flight in 16 launches.

Nose cone was fired downward into the atmosphere in a re-entry test of ablation characteristics during a Black Knight flight from Woomera, Australia, May 24. Black Knight carried a solid propellant second stage which was fired downward when it had fallen within 70 mi. of the earth.

Litton Industries has won Navy competition to develop an automatic stellar-inertial navigation system for use in advanced long-range Navy aircraft. Kollsman Instrument will provide star-tracking element of the system under contract to Litton. Program will be monitored by Naval Avionics Facility at Indianapolis (NAFI).

SIPA, French aircraft company mainly engaged in subcontract work, is designing a five-ton twin-boom cargo aircraft called the Presence 270. Powerplants will be two Turbomeca Astazou turboprops of 500 shp. each. Payload would be 12 first-class passengers, 16 in economy class. Cabin is pressurized.

Strategic Air Command will begin testing Minuteman railroad equipment and techniques June 20, using the facilities of 13 U. S. railroads. Special train will make six trips in a test series scheduled for completion by November.

Air Force has awarded a $12 million contract for research and development work on graphite to National Carbon Co., a division of Union Carbide Corp. Company will build a laboratory at Lawrenceburg, Tenn. for part of the work. USAF is interested in graphite as a structural material for missiles and space vehicles because of its strength at high temperatures.

Nationalist Chinese air force is getting Lockheed F-104 supersonic day fighters under the Military Assistance Program (AW Nov. 23, p. 30). First two fighters were delivered late last month to Kuan Air Base, Formosa.

Airlines Will Fight Transport Integration

ATA wins right to enter ICC case considered test of railroad drive for common ownership authority.

By L. L. Doty

Washington—Domestic scheduled airlines won the right last week to intervene in an Interstate Commerce Commission hearing which the airlines view as a primary test case in the current drive of major U. S. railroads to enter air transportation.

The ICC case, involving the proposed sale of the John I. Hay Co. barge line to the Illinois Central and Southern Pacific railroads, again focuses attention on the growing conflict between the rail and air industries over integration of all modes of transportation either through direct acquisition or new entry. Air Transport Assn. was accepted as a party to the case in behalf of the airlines.

So far this year, six bills have been introduced in the House and three in the Senate, each of which is written to facilitate common ownership of two or more forms of transportation. The airlines have vigorously opposed these bills and have intervened in the ICC case on grounds that the final decision will set a precedent in the issues at stake.

Thus the battle lines between the two industries are clear, with the railroads gaining impressive support in their drive to remove restrictions that prevent them from operating air services or handicap them in conducting highway or waterborne operations. Airlines are fighting for complete independence, charging that the railroads seek a free and unrestrained entry into air transportation that will damage competition.

The controversy has brought out several policy statements in recent months that indicate few governmental agencies are ready either to open or close the door decisively on the prospect of common ownership. For example, the Commerce Department, in its recent report on a federal transportation policy, made this somewhat ambiguous statement:

"Generally, control of one mode of transport by another is neither necessary nor recommended, although a more flexible attitude on the part of the regulatory authorities is desirable where a clear demonstration can be made that increased efficiency will result."

Alan S. Boyd, newly appointed member of the Civil Aeronautics Board, recently made this statement, leading industry observers to believe that common ownership is not a closed issue as far as the CAB is concerned:

". . . It is my judgment that the use of combined or joint rates with other type carriers can help achieve the potential in [air] freight. Without vigorous action in this direction, the time may well arrive when common ownership of different modes of transportation will be not only permitted, but encouraged by Congress."

Railroads contend they are "effectively precluded" from engaging in air operations, are prohibited from operating interstate truck service under the same terms and conditions applied to non-railroad operators and, as the law is applied, cannot operate inland waterways except "upon a special showing."

They charge that present restrictions stem from language used in the Interstate Commerce and Federal Aviation Acts. They add that such policies have resulted from administrative interpretation rather than from specific terms of the statutes.

It has been established that the Federal Aviation Act of 1958 does not prohibit the entry of railroads into the air transportation field and that acquisition of an airline by a railroad is possible if it can be proved that such a transaction will "promote the public interest by enabling such carrier other than an air carrier to use aircraft to public advantage in its operation and will not restrain competition."

In protesting the House bills, John Stephen, ATA general counsel, concluded that the railroads were proposing more than the limited entry into air transportation possible under the wording and interpretations of the Aviation Act. He said:

"This proposal is in direct conflict with long-established and frequently reaffirmed congressional policy in preserving the independence of the various forms of transportation."

Stephen argued that integration would lead to transport monopoly. He said that the general public interest "would not be promoted by permitting all modes of transportation to gravitate into a few general private transport companies with fewer centers of control."

The railroads have labeled the charge of monopoly as "hollow." They point out that, even with the removal of existing restrictions, all applicants—including the railroads—would be required to justify their entry into other areas as in the public interest.

All bids for acquisition of existing carriers or for new entry will require consideration of the competitive effect by the regulatory agency ruling on such cases, they say.

In his testimony before the Interstate Commerce Commission last week, ATA President Stuart G. Tipton drew a parallel between the barge lines and airlines in their relationship to the railroads. He said:

"Both air and barge lines have small investments relative to those of the railroads, hence railroad control of either would be detrimental to the interests of the controlled mode. Both compete with the rails. Both have experienced a spectacular growth period since World War II and are hopeful that such growth will not be brought to an end through railroad control."

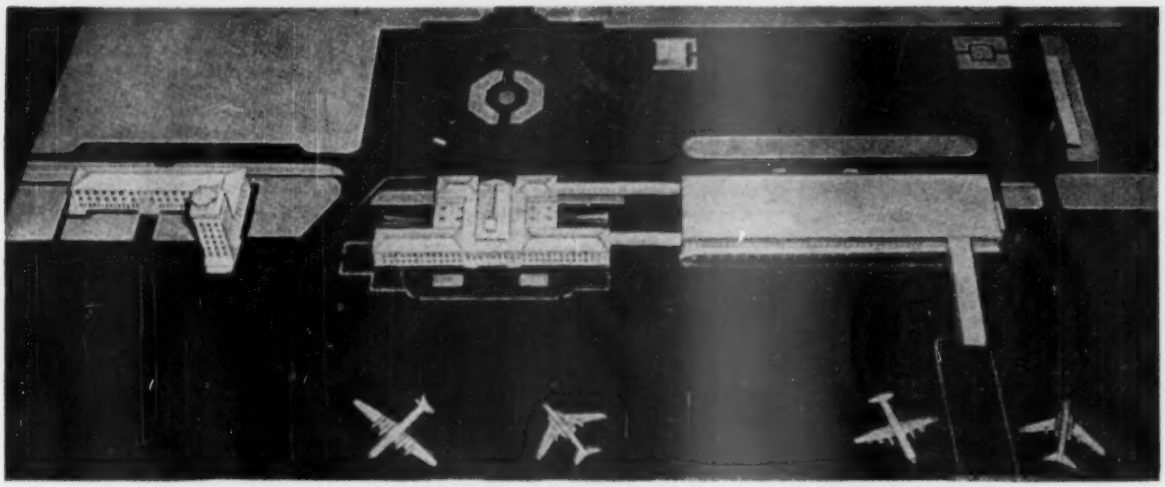
Tipton pointed to the heavy capital outlays made by the airlines in recent re-equipment programs and said he doubted that, if the airlines had been under the control of "conflicting" transport interests, the public would have available to it the air transport industry it now has today.

Although other forms of transportation are opposed to railroad proposals for common ownership, they are in general agreement that joint rates and fares must be developed if a properly coordinated transportation system is to be maintained. The Federal Aviation Act of 1958 allows for the development of such rates and provides for creation of a joint board composed of members of the ICC and the CAB with full jurisdiction over through-services and rates.

American Sues TWU

Tulsa—American Airlines filed a $684,703 damage suit here last week against Transport Workers Union for an alleged "unlawful walkout" of Local 514 Mar. 31-Apr. 4. The suit was filed in U. S. District Court.

On Apr. 27, American was granted a permanent injunction against the union which, the airline said, ended a five-day work stoppage at its Tulsa base and slowdowns elsewhere in its system.



New Passenger Wing, Tower for Vnukovo Airport

Construction has begun on the new, two-story passenger wing at Moscow's Vnukovo Airport. Shown to the right of the present terminal, which is in the center of sketch, the new structure will accommodate "up to 2,000 passengers" at one time. It will be connected to the existing terminal by galleries. Completion is scheduled for 1961. Proposed new control tower and administrative offices are shown at left.

Aeroflot Modernizing Medium-Haul Fleet

Moscow—Aeroflot is embarking on a new re-equipment program to replace its medium-haul, piston-powered Il-14 fleet with new turbojet and turboprop equipment, according to Col. Gen. Yogveni Loginov, head of the Soviet airline.

The new medium-haul transports are:

• **Tu-124 powered by four Soloviev** turbojet engines described by Soviet sources as of "double contour" design. Emphasis on the outstanding fuel economy of the new Soloviev jets indicates this designation may be a translation jumble meant to describe turbofan engines. The Tu-124, prototype of which was rolled out last December, was originally thought to be a supersonic design. Gen. Loginov said it resembled the Tu-104 in general configuration but had a 46 passenger capacity and maximum speed of 560 mph. (900 km.). Maximum nonstop range was listed as 1,000 mi., cruising at 32,000 ft. altitude.

Gen. Loginov said the Tu-124 could use any runway from which the Il-14 now operates, while other Soviet sources quoted a 2,500 ft. runway requirement for the new transport.

• **An-24 powered by turboprops.** No further details were available on this new designation other than that it is a product of the design bureau of Oleg Antonov and probably uses a new design Kuznetsov engine of lighter weight and better fuel economy than the original series of Kuznetsov and Ivchenko turboprops used on the An-10 transport. Gen. Loginov said the An-24 would also be used as an Il-14 replacement, presumably in the areas where grass airfields still predominate.

Soviet designers have been working on supersonic transport designs, according to Gen. Loginov, who said he plans to introduce this type to Aeroflot in a "few years."

"I don't know who will be first to have a supersonic transport," he said, "but we won't be the last."

In addition to its negotiations for international service between Moscow and New York, Aeroflot is also planning to extend its foreign routes to Japan and Indonesia, according to Gen. Loginov. He said Aeroflot had conducted talks at the technical level in both Japan and the United States but that no governmental level approach had yet been made in Japan similar to the official U. S. negotiations scheduled to begin in New York July 18.

Aeroflot hauled 20 million passengers during 1959, a total equal to its combined passenger traffic from 1950 to 1955, Gen. Loginov said in providing the first absolute traffic figures the Soviet airline has ever released publicly. The record 1959 traffic total was the first reflection of the impact of large scale jet service by Tu-104A and B models, the Il-18 turboprop and the An-10. Gen. Loginov made no specific reference to the Tu-114 which is still flying a weekly proving flight between Moscow and Khabarovsk on the trans-Siberian route.

The Aeroflot route pattern as it is now developing utilizes the Tu-104B and the Il-18 on its main trunkline services, with the Tu-124 and An-24 scheduled to operate medium haul service between large cities. The Il-14 piston engine fleet that has been operating the medium haul routes will be pushed back to a feederliner service connecting some 1,000 smaller towns with the big city traffic hubs. Role of the An-10 is still not clear.

Aeroflot is aiming at reaching a 50 million passenger level by 1965, according to Gen. Loginov, who predicted that when the current seven year plan ends in that year, 50-60,000 passengers would be moving through Moscow air terminals daily.

Air cargo volume is being increased from 30 to 40% this year over 1959 with major emphasis on flying fruits and vegetables from the southern regions to the large industrial cities of the north. Helicopter service passenger volume increased 10% in the first four months of this year compared to the same period in 1959, and new types of helicopters are being developed for building electric power transmission lines and oil and gas pipelines.

All international air service by Aeroflot and the foreign flag carriers serving Moscow shifted on June 1 from Vnukovo to Sheremetyevo airfield because the facilities at the older airport were swamped by the increasing traffic volume, particularly those for handling foreign passengers. Gen. Loginov noted that new terminal facilities had been under construction at Vnukovo for two years and said "we simply couldn't wait any longer." Sheremetyevo has a new passenger terminal, but it has only a single runway about 7,000 ft. long with high intensity approach lights at both ends and GCA landing aids. A western-style instrument landing system is scheduled for installation there next fall.

Flight Recorder Competition Grows As ATA Asks Deadline Extension

Washington—Competition to provide the airlines with an all-purpose flight recorder is gaining momentum in the wake of a Federal Aviation Agency proposal to require the mandatory installation of recorders on all turbine-powered aircraft by Sept. 1 (AW May 16, p. 38).

Although it doesn't record all the data taken by the all-purpose systems, the Lockheed Aircraft Service Model 109-C four-channel recorder currently in use on most airlines is still a leading contender in the competition. It doesn't provide maintenance data, but the company argues that it is logically suited to record the accident data required by the FAA proposal, and it could be delivered on short notice in sufficient quantities to meet airline needs.

At the same time the Air Transport Assn. has asked FAA to extend the installation deadline until May 15, 1961, to give many carriers an opportunity to evaluate the more sophisticated, multichannel magnetic tape recorders, which can provide both accident and maintenance data.

The same date would also serve the purpose of many carriers which intend to use the LAS 109-C recorder, ATA said. One of the largest prospective users—Capital Airlines with a fleet of 56 turboprop Viscounts—plans to install the LAS aluminum foil type recorders during aircraft inspection periods at the rate of six units a month, with installation completed by May 15, 1961, ATA said.

ATA's request has spurred the sales programs of other manufacturers offering more complex recorders with greater capabilities, such as the Minneapolis-Honeywell Regulator Co., and the Waste King Corp.

Lockheed Aircraft Service also has entered the field of multi-channel recorders under a sales agreement with Royston Instruments of England, to market the British firm's "Midas" magnetic tape recorder in this country. Lockheed said the new equipment will be sold under the name of Lockheed Maintenance Recording System. First units would be ready for delivery by November, with shipments expected to reach 20 a month by January.

Minneapolis-Honeywell recently conducted a flight demonstration of its AG-8 magnetic tape recorder in a DC-3 for the FAA. On a spool of 2-in. tape, the AG-8 records altitude, airspeed, heading and vertical acceleration once each second to meet FAA's requirements for accident analysis.

The unit also contains one digital channel which can be used to record up to 60 other data inputs at a sampling rate of one per minute, plus a separate audio channel for in-flight pilot observations to be recorded along with performance data. Spools of magnetic tape last 150 hr., and within their heavily insulated housing can withstand a temperature of 2,000F for 15 min. and exposure to salt water for 36 hr. Playback can be accomplished through the use of an aircraft instrument type display, a Visicorder, digital counter and printer or large-scale digital computer. Honeywell estimates the new flight recorder will sell for less than $10,000 and will be available in December, with delivery at 20 a month by January.

Waste King Corp. flight recorder uses a metallic-coated tape which records by means of stylus engravings on both sides of the tape at the rate of twice per second. All of the required FAA information can be recorded on one side, and as many as 20 extra data channels are available on the other side, the company said. The unit's tape magazine holds 200 ft. of tape which will last 200 hr. and will withstand a 2,000F fire, 100g shock and immersion in salt water for 36 hr.

Four levels of read-out are available with the Waste King, including printed calibrations on the tape; projection of the record onto a screen; semiautomatic methods to digitize information directly and a fully automatic data reduction system which would allow the reduced data to be fed directly into computers. Waste King said it has designed such a reduction system and will manufacture the equipment if there is a demand.

Waste King said its recorders now are being produced and shipped at the rate of 30 a month and this is expected to reach 100 a month in the near future. Cost of the unit was quoted at $6,500, with 125 man hours needed for installation. The company has sold an estimated 300 units to date.

Delta 880 Damaged In Landing Incident

New York—Delta Air Lines Convair 880 which returned to New York International Airport last week after failure of its No. 1 hydraulic system started into a Dutch roll condition on its final approach to the runway. The jet transport was still yawed when it made contact with the runway, and scraped its No. 4 engine pod during the landing.

No injuries to the 72 passengers and six crew members were reported. The flight was scheduled nonstop to Atlanta.

The plane approached the runway at 178 kt. with 20 deg. flap. The nose gear was lowered by hand because hydraulic power was inadequate. The pilot had only ailerons for roll control because the spoilers could not be activated. Ailerons should provide 20% of lateral control, spoilers the other 80%.

The Dutch roll began at about 100 ft. altitude about ¼ mi. from runway.

The 880 is provided with a No. 2 hydraulic system designed to do the full job as long as there is high boost on the pumps. Inadequate power from this system could result from the pumps not putting out enough power, switches being improperly set, or failure of the system. Captain of the 880 did not declare an emergency. Damage to the aircraft was slight.

Board Denies Permit For BOAC Charter

Washington—Civil Aeronautics Board denied last week the application of British Overseas Airways Corp. to operate eight round-trip transatlantic charter flights for the Joint Committee of the Councils of the Bar and Law Society of Great Britain.

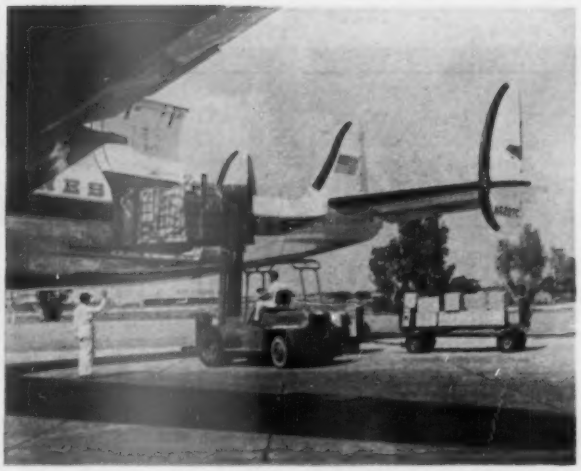
Board based its action on the finding that the charters would not be bona fide since passengers on the flights would be able to select which of the eight flights they wished to travel on instead of flying as a group going and returning. This is termed intermingling and is prohibited by the Board's Economic Regulations.

Charters were planned to transport members of the Joint Committee to Washington for the annual meeting of the American Bar Assn., Aug. 29 to Sept. 2, and the Commonwealth and Empire Law Conference in Ottawa, Can., Sept. 14-21. Seven of the westbound flights would have terminated in Washington, the eighth in New York. Eastbound, six of the flights would have originated in Buffalo, N. Y., and the remaining two in New York.

The Board also pointed out the combined membership of the Joint Committee is 19,903, which is higher than the 15,000 maximum set by the International Air Transport Assn., of which BOAC is a member.

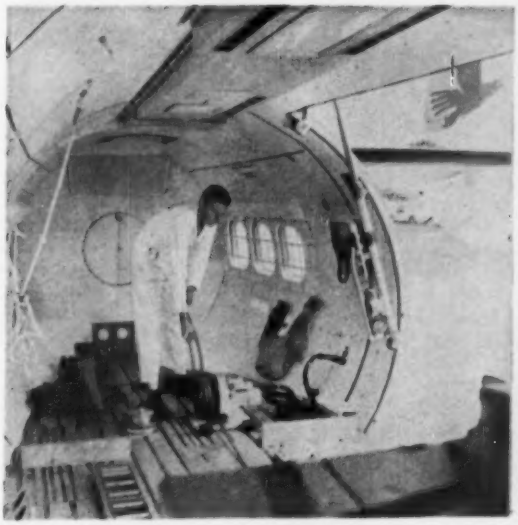
CAB sets a maximum of 5,000 members for an organization, and the Board said any larger group would be ineligible to participate in charter trips.

CAB said BOAC, its travel agent and the Joint Committee would have to accept the responsibility should the flights be carried out ". . . in face of the carrier's own rules prohibiting charters drawn from a membership of this scope, and in face of the Board's long-established size standards and prohibition against intermingling."

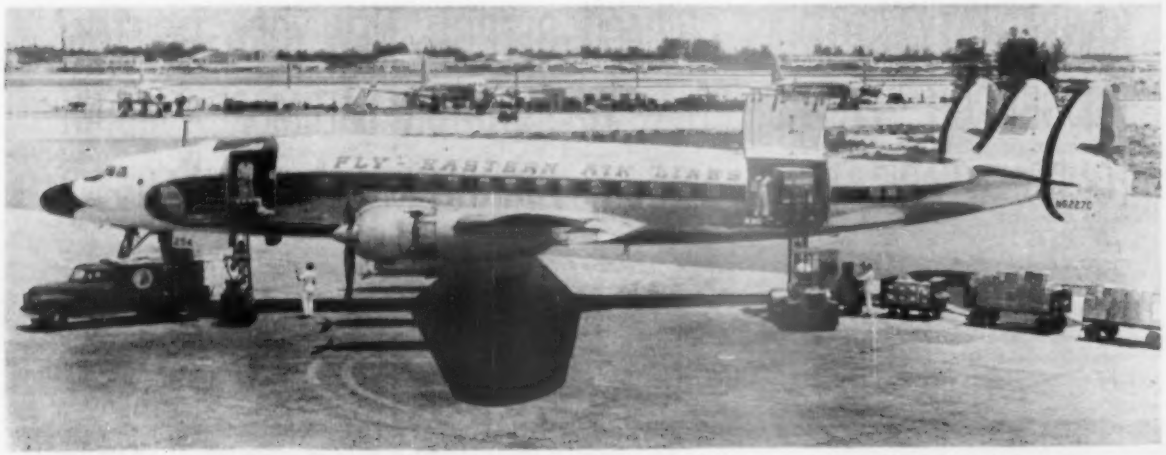


Cabin of Eastern Air Lines' Flying Freighter shows roller tracks, reinforced flooring, barred windows and tie-down fittings on fuselage wall. Loading of up to 34,000 lb. payload for each of the five converted Super-C Constellations is speeded by fork-lift trucks.

Eastern Converts Super-Cs to Cargo Freighters



Cargo handling equipment at after end of cargo cabin includes hydraulic loading door, intercom telephone, roller tracks and portable electric windlass and capstan for loading and unloading palletized cargo. At right cargo is anchored to reinforced floor and tie-down system with special nets and straps.



Eastern's Flying Freighter will provide overnight nonstop service at 329 mph., linking any cities on Eastern's system.

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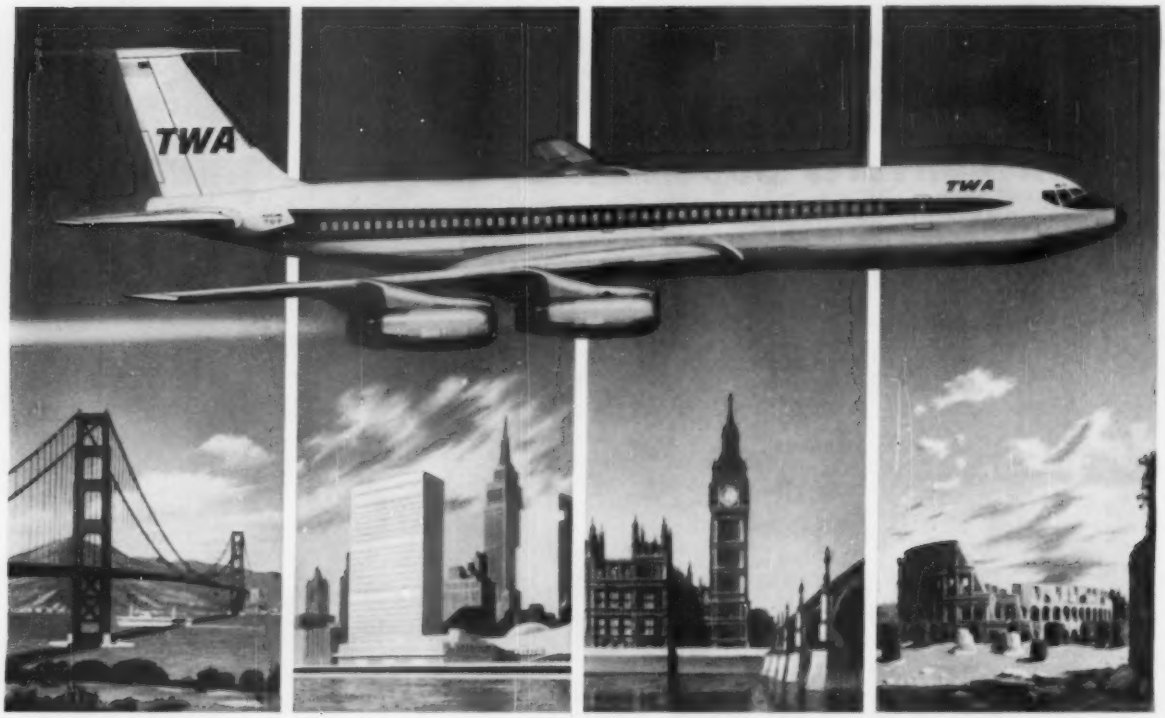

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Capital Employe Group Begins Proxy Fight

Washington—A group of Capital Airlines employe-stockholders last week made good a threat to conduct a stockholder proxy solicitation as a first step toward overthrowing the airline's present board of directors and at least part of its operating management.

The dissident group, called the Capital Shareholders Assn. and numbering over 2,100 members holding some 20,000 shares of common stock (AW May 9, p. 39), mailed proxies to more than 6,000 shareholders calling for a special stockholders' meeting for the purpose of replacing the board of directors with a slate of its own. Under the bylaws of the corporation, such a meeting can be called by a vote of 25% of the outstanding shares of common stock.

Meanwhile, Capital's management last week expressed some confidence that it would escape from the fiscal plight brought on by a series of heavy losses and a suit filed by Vickers-Armstrongs asking the appointment of a receiver to sell Capital's fleet of Viscounts to pay $33 million due on unpaid notes (AW Apr. 18, p. 38). Airline officials said the company is negotiating with U. S. representatives of Vickers in an attempt to settle financial problems out of court.

Here are the latest actions which Capital officials feel will help ease the pressure which has mounted against the company during the past two months:

• **Thomas D. Neelands, Jr.**, a New York investment banker, replaced George Hann as board chairman when the latter declined to stand for re-election (AW May 23, p. 38). Neelands assumes the job of developing a refinancing plan that will not only be acceptable to the British noteholders but will enable the airline to restore its re-equipment program calling for the purchase of a fleet of Convair 880 turbojet and Lockheed Electra turboprop transports.

• **Vickers-Armstrongs** asked for a 10-day postponement of its court foreclosure suit against Capital on May 28, the second postponement the carrier has received since the suit was filed Apr. 18 (AW Apr. 25, p. 43). The first postponement was granted by the court over the vigorous protests of Vickers.

• **Capital withdrew its request** to the Civil Aeronautics Board for subsidy on grounds that a fare increase would nullify the need for such aid. Capital has filed a tariff calling for a rate increase of 4% plus $1 on each ticket. The carrier estimates this will give it an additional $7 million in revenues during 1960. Capital also asked that a full-scale CAB probe be called off in conjunction with the withdrawal of the subsidy request (AW Apr. 18, p. 38).

CAB complied with the Capital request and dropped the investigation, which was originally set to determine whether the airline's routes and operating certificates should be dismembered or whether the carrier should be merged in part or whole with other carriers.

Charles E. Beatley, veteran senior pilot with Capital and president of the Capital Shareholders Assn., found nothing in these actions that would persuade him to either drop or defer his plans to overhaul Capital's management. On the subject of subsidy, he said:

"I assume that Capital withdrew its subsidy application because of its apparent fear of the CAB's promised investigation and a realization that the subsidy was not likely to be granted anyway."

The group was even less sympathetic with the appointment of Neelands and described the "widely publicized 'shake-ups' in Capital's management" as "mere window-dressing." Charging that the airline's management is "still wandering in a wilderness," the group had this to say about the changes in the directors structure (AW May 30, p. 41):

"Except for a new chairman, the board remains the same group whose mistakes have led Capital to the verge of bankruptcy. All we can see in the vaunted management reorganization is a consolidation of some jobs and no sign that the drastic action so badly needed is going to be taken in the near future."

Thus far, Capital's top management has made no overt move to prepare for an internal battle against the attempts by the employes' group to overturn the board of directors, although it has started an incentive program designed to enlist the aid of all employes in accelerating sales and improving operating performance as one means of getting the company back on its feet. The programs, which began last week, provide for prizes to employes who make the largest contributions in these areas.

Meanwhile, the Capital Shareholders Assn. has not attracted new recruits in any great numbers since the first surge of applications following the Vickers-Armstrongs suit brought membership up to 2,150, about 30% of the total work force of the airline.

Privately, a number of Capital officials conceded that the insurgents could be successful in capturing control of the company, although there were some who doubted that the average stockholder would be willing to relinquish his vote to a group allegedly inexperienced in management functions.

The association will use all its members in the solicitation of proxies and will request that all such work be conducted during the employes' off-duty time. Such solicitors—consisting mainly of pilots, hostesses, sales personnel, mechanics and clerks—will not be compensated for their work.

In addition, the association will ask brokerage houses, custodians and others who hold stock in their names to solicit proxies from persons owning such stock. It is estimated that 53% of some 909,000 shares outstanding is held in the street name of brokers. William A. Kissel of New York has been retained at a fee of $1,500 to aid in the solicitation of proxies of stock held by brokerage houses.

According to the proxy statement issued by the association, cost of solicitation will amount to approximately $13,500, of which approximately $4,400 has already been spent. Reimbursement for such expenditures will be sought from Capital Airlines, the proxy statement said.

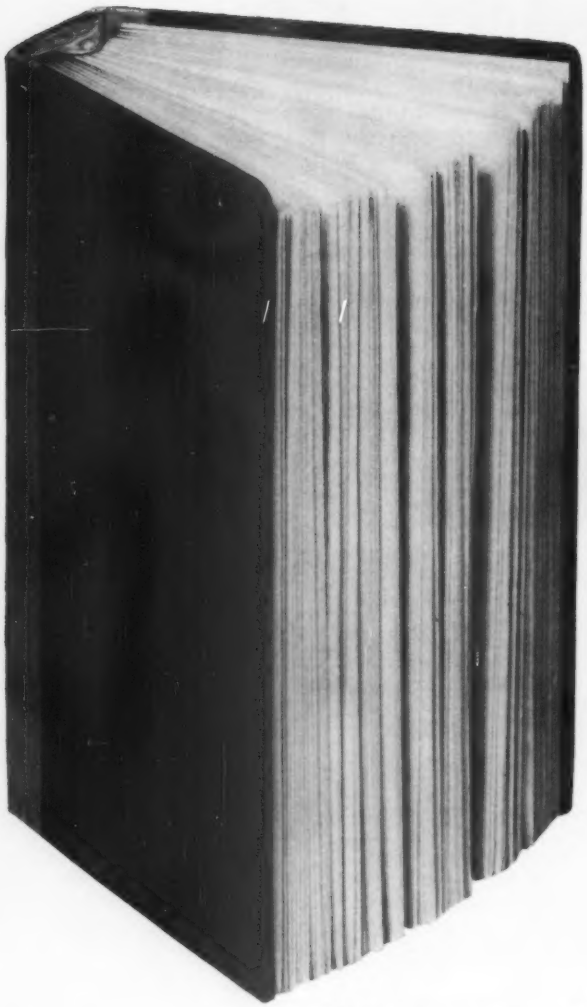
Bond Group Formed

New York—A committee to protect the interests of holders of about $12 million in Capital Airlines debentures has recently met with other parties concerned with Capital's financial troubles in an effort to negotiate a solution. The Capital Airlines, Inc., Debenture Holders Protective Committee does not plan any action against the airline at this time, since Capital has been meeting its semi-annual debenture payments. Next payment is due July 1.

The committee, under the chairmanship of Gordon Y. Billard, managing partner of Carreau and Co., has met with Capital management, with Bankers Trust Co., the debenture holders' trustee, with Vickers-Armstrongs, Capital's British creditor, and with counsel for the trustee and Vickers. The committee is assisting in the effort to work out a solution and may provide some new financing.

The debenture holders' protective committee was formed shortly after Vickers announced its foreclosure plans. Billard recently advised the debenture holders by letter of the committee's organization to protect the holders' investment in view of "recent disturbing developments" concerning the airline.

"The committee does not intend at this time to solicit support from other debenture holders but does intend to follow events closely and to take such action as may be necessary for the protection of the debenture holders," Billard wrote.



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Congress Weighs New Authority for CAB

By Robert H. Cook

Washington — Congress weighed changes in the Federal Aviation Act last week which would permit supplemental airlines a type of scheduled service recently challenged by the U. S. Court of Appeals.

Civil Aeronautics Board has suggested changes in the act which would clearly give the Board power to issue the kind of operating authority under which supplementals now fly. This CAB authority was questioned recently by the Court of Appeals (AW Apr. 18, p. 40), and the Board moved under a June 7 court deadline to get the authority it needs from Congress.

If congressional action is not fast enough to meet court deadlines, or if Congress refuses CAB the authority it wants, the effect of the Court of Appeals decision on the supplemental carriers may be delayed by an appeal to the Supreme Court.

Senate and House aviation subcommittees are considering legislation that would amend the Federal Aviation Act to permit CAB to certificate the supplemental carriers for limited scheduled operations. Preparation of the legislation came in the wake of a decision from the U. S. Circuit of Appeals which last month ruled that the Board exceeded its authority in granting three to five year temporary operating certificates to 25 supplemental airlines in January, 1959.

Court said the CAB failed to comply with the Federal Aviation Act by granting blanket authority for the airlines to operate between any two points in the U. S. on schedules not to exceed 10 trips a month in the same direction. The award of unlimited charter authority to the carriers was not contested by the court, which ruled on appeals filed by United, Eastern, Pan American, Trans World, American, Delta, Northwest and National airlines, and the Atcheson, Topeka & Santa Fe Railway.

Effect of the bills under consideration would be to clarify and strengthen CAB's authority to issue certificates for supplemental scheduled service and thus uphold the present status of supplemental carriers.

CAB officially supported the changes in hearings, but the subcommittees heard conflicting testimony from the Board. Chairman Whitney Gillilland favored maintaining the status quo of the supplemental lines plus other measures that would strengthen them, but Vice Chairman Chan Gurney urged that the carriers be stripped of much of their present powers and restricted to charter flights.

Gillilland said immediate legislation is needed to "meet the grave problems" of the supplemental industry, and he expressed doubt that, once the Court of Appeals order becomes effective, CAB can permit the supplementals to operate by means of exemptions because of past court decisions on similar issues. He urged passage of legislation which would clearly make legal the Board's actions in granting supplemental operating certificates in their present form, in addition to awarding them permanent operating rights.

Contesting court criticism that the Board had granted certificates to many airlines financially unable to carry out any large scale operations, Gillilland also recommended that any new legislation contain a stipulation that a determination of financial fitness of such a carrier be related solely to its ability to conduct a supplemental operation, "rather than to an obligation to perform a nationwide service."

Gurney criticized the supplemental operations and told the subcommittees the service provided by scheduled trunk and local service airlines is adequate. Based on more than nine years of service as a CAB member, Gurney said, there is "little need" for supplemental operations. He recommended that the carriers be confined to unlimited charter services. Of a total of 25 supplemental air carriers which received their operating certificates last year, he said, 10 failed to conduct any individually ticketed flights prior to June, 1959, and four of these failed to operate a revenue flight of any kind.

"It is my firm belief that the future of the supplemental industry lies in the further development of the charter market and not in attempting to engage in route type operations of any kind," Gurney said.

Gurney also took issue with a proposed amendment to the Federal Aviation Act which would permit the CAB to expand the supplementals' authority to include overseas and foreign air transportation. Noting the heavy competition U. S. flag carriers face from foreign airlines over international routes, he told Congress that adding the supplemental carriers to this market might "pose a further threat" to the financial condition of the carriers on the routes.

Stuart G. Tipton, president of the Air Transport Assn., generally supported Gurney's stand and opposed the CAB-favored legislation. ATA would also limit the supplementals' authority to all-charter service but objects to any legislative changes which it contends might permit the Board to regulate schedules or issue certificates without specifying points to be served. Tipton said CAB had ignored the basic concepts of carrier fitness and public service needs in authorizing the supplemental services and urged a reappraisal of the situation.

Clayton L. Burwell, president of the Independent Airlines Assn., told committee members that following ATA's recommendations would have the "inevitable effect" of eliminating supplemental airlines from the industry. Maintaining that CAB action in the Large Irregular Case last year eliminated all but a "handful" of supplemental airlines from operation, Burwell charged ATA with conducting delaying tactics during the hearings in the hopes that Congress may not act in time to help the supplemental industry. He added that without congressional aid, "there will be no further problems from the supplemental industry to prevent a complete dominance of the air transport industry by a small, determined group of large carriers."

Vanguards Grounded Due to Tyne Problem

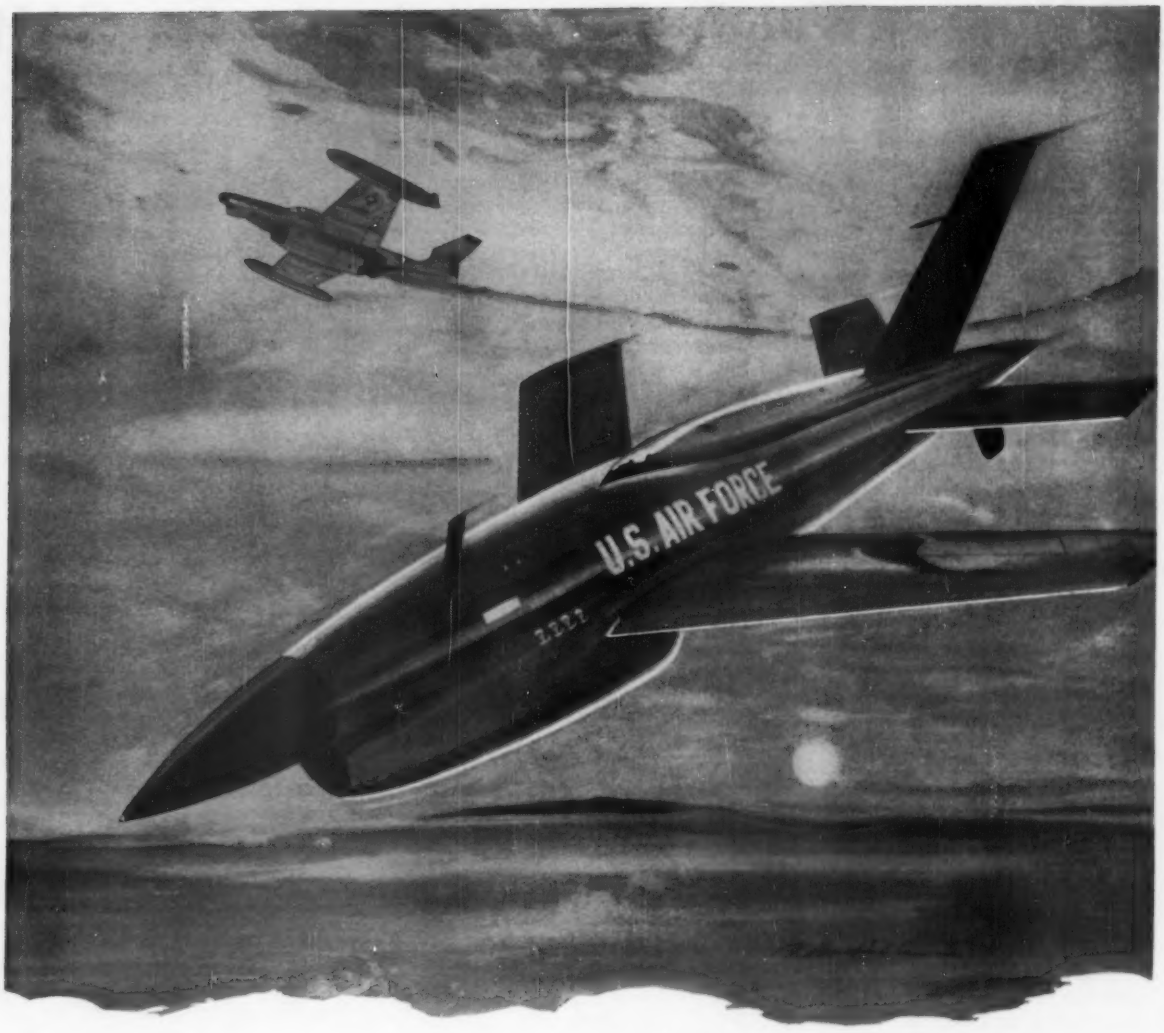
Vickers Vanguard aircraft has been grounded because of a compressor wheel failure of the Tyne turboprop powerplant during a test run by Rolls-Royce. Grounding, effective May 23, also halts flight tests of the Canadair CL-44 at Montreal.

The Vanguard was due to enter service on the London-Paris route of British European Airways early in July. The short-to-medium range aircraft, which carries up to 139 passengers, also was scheduled to begin service with Trans-Canada Airlines this September. Very likely the introduction of both these services could be delayed.

Cause was the shattering of one of the 15 compressor disks of an engine on a static acceptance test. Examination of other engines awaiting delivery revealed cracking in one other disk.

Failure marked the first serious trouble spot of the high-temperature turboprop, designed to grow to 10,000 tehp. (AW Nov. 9, p. 98). Tyne Mk. 12 produces 5,545 tehp. on takeoff at 15,250 rpm.

Rolls-Royce does not at this point suspect any inherent design defect. Minimum effect of the grounding would be a slight delay in deliveries of the engine. Most likely cause of the compressor wheel failure are local defects in a rogue batch of disk metal which, if true, would result in only slight delays to the introduction of Vanguards on scheduled service.



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Airlines List Officer Salaries With CAB

Washington—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses and stock holdings for the year ending Dec. 31, 1959, as reported to the Civil Aeronautics Board:

Northwest Airlines, Inc., (carrier did not list bonuses or indirect compensations for officers— **D. W. Nyrop**, president and director, $75,000 salary, $6,523 expenses and 14,900 shares of common stock; **G. M. Bain**, vice president-sales, $32,500 salary, $2,437 expenses and 1,200 shares of common stock; **P. L. Benscoter**, vice president-Orient Region, $19,700 salary, $4,103 expenses and 1,900 shares of common stock; **W. J. Eiden**, treasurer, $26,500 salary, $2,736 expenses and 4 shares of common stock; **A. E. Flaan**, vice president and secretary, $22,000 salary, $963 expenses and 405 shares of common stock; **F. C. Judd**, vice president-maintenance and station operations, $31,500 salary, $2,090 expenses and 1,205 shares of common stock.

C. L. Stewart, vice president-plans, $18,500 salary, $6,567 expenses and 500 shares of common stock; **A. D. Piepgras**, assistant comptroller, $13,500 salary, $753 expenses and 200 shares of common stock; **D. H. Hardesty**, assistant treasurer, $14,000 salary, $250 expenses and 710 shares of common stock; **F. J. Scott**, assistant secretary, $12,375 salary, $106 expenses and no stock; **D. Merrick**, assistant vice president-properties, $14,250 salary, $503 expenses and 700 shares of common stock; **C. Hunter**, chairman of the board, $25,000 bonus and indirect compensation, $2,514 expenses, 3,300 shares of common stock and 1,500 shares of 5¼% preferred stock.

W. Stern, director, $9,600 bonus and indirect compensation, $4,611 expenses, 1,000 shares of common stock and 1,000 shares of 5¼% preferred stock; **L. C. Glotzbach**, vice president-personnel (resigned 6/30/59), $11,458 salary, $171 expenses and no stock; **P. T. Drotning**, vice president-public relations (resigned 12/31/59), $19,500 salary, $13,208 expenses and no stock; **M. S. Mackay**, director (resigned as executive vice president 7/31/59), $17,500 salary, $1,547 expenses and 2,000 shares of common stock.

Following directors were not paid a salary, bonus or indirect compensation: **J. H. Binger**, $600 expenses and 2,826 shares of common stock; **H. Case**, $607 expenses, 20,000 shares of common stock and 24,000 shares of 5¼% preferred stock [1]; **M. H. Fry**, $1,607 expenses, 14,000 shares of common stock and 700 shares of 5¼% preferred stock [2]; **T. B. Gamble**, $619 expenses and no stock; **J. T. Johnson**, $1,245 expenses and 1,000 shares of common stock [3]; **C. B. Morgan**, $1,391 expenses and no stock; **A. Petteys**, $1,086 expenses, 21,000 shares of common stock and 7,000 shares of 5¼% preferred stock [4]; **C. F. Reavis**, $600 expenses, 3,500 shares of common stock and 1,167 shares of 5¼% preferred stock; **A. G. Redpath**, $1,152 expenses and 1,000 shares of common stock; **L. E. Wakefield, Jr.**, $800 expenses and 1,000 shares of common stock; **A. J. Weatherhead, Jr.**, $691 expenses, 3,150 shares of common stock and 1,000 shares of 5¼% preferred stock.

Following firms were paid for services rendered during 1959: **H. L. Cummings**, public relations $7,898; **Doherty, Rumble & Butler**, legal, $29,870; **Ernst & Ernst**, accounting, $41,772; **Harold R. Harris**, payment to former president under termination agreement dated Mar. 4, 1954, $10,000; **Gerald Hazzard**, artist, $5,126; **Hodges, Reaves, McGrath & Downey**, legal and financial, $136,772; **Claude J. Jasper**, legal, $8,926; **Jasper, Winner & Perina**, legal, $7,558; **Koteen & Burt**, legal, $32,298; **C. Edward Leasure**, legal, $45,000.

Leasure & Pendleton, legal, $18,929; **Mayo Clinic**, medical, $24,130; **White & Case**, legal $15,407; **Klagsbrunn, Hanes & Irwin**, legal, $12,111; **Dorsey, Owen, Scott, Barber & Marquart**, legal, $15,399; **Pogue & Neal**, legal, $28,555.

Footnotes: [1] All stock owned by **Case, Pomeroy & Co.** directly and/or through its wholly-owned subsidiary, **Essex Royalty Corp.**, of which Case is president. [2] 12,000 shares of common stock owned by **Overseas Securities Co., Inc.**, of which Fry is president, a director and substantial stockholder. [3] Stock owned by **Milwaukee Co.**, of which Johnson is president. [4] $1,666 preferred shares of 5,000 common shares owned by **Denver Basin Oil Co.**, of which Petteys is chairman of the board; 334 preferred shares and 1,000 common shares owned by **High Plains Realty Co.**, of which Petteys is a director.

Chicago Helicopter Airways, Inc.—**John S. Gleason, Jr.**, president treasurer and director, $15,000 salary, no bonus or indirect compensation, $291 expenses and stock held in voting trust; **C. W. Moore**, executive vice president and director, $25,000 salary, $3,000 bonus and indirect compensation, $2,397 expenses and stock held in voting trust; **R. B. Kiel**, assistant secretary and assistant treasurer, $12,500 salary, $750 bonus and indirect compensation, $831 expenses and no stock; **R. S. Angstadt**, vice president-operations, $16,500 salary, $750 bonus and indirect compensation, $2,334 expenses and stock held in voting trust.

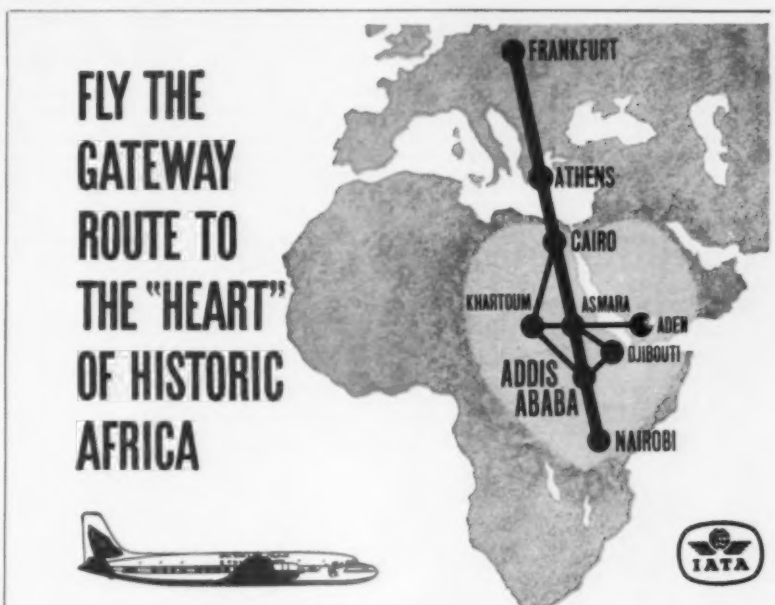
J. C. Brogan, vice president, secretary and director, $9,600 salary, no bonus and indirect compensation, $64 expenses and stock held in voting trust; **C. E. Liske**, vice president-traffic and sales, $9,600 salary, $750 bonus and indirect compensation, $2,578 expenses and stock held in voting trust; **W. Kirkland**, director, no salary, bonus, indirect compensation or expenses with stock held in voting trust; **J. P. Ringley**, director, $4,800 salary, $750 bonus and indirect compensation, $181 expenses and stock held in voting trust; **R. A. Podesta**, director, no salary, bonus, indirect compensation or expenses with 120 shares of common stock; **A. C. Stepan, Jr.**, director, no salary, bonus, indirect compensation or expenses with 200 shares of common stock.

Following firms were paid for services rendered during 1959: **Kirkland, Ellis, Hodson, Chaffetz and Masters**, legal $9,437; **Arthur Anderson & Co.**, accounting, $8,440; **Pogue & Neal**, legal, $11,935.

Los Angeles Airways, Inc.—**C. M. Belinn**, president and director, $25,000 salary, $5,000 bonus and indirect compensation, $2,219 expenses, 6,010 shares of common stock, 60 shares of common stock held jointly with **Christina M. Belinn** and 27 shares of common stock held jointly with **Melvina M. Belinn**; **J. T. Kane**, treasurer, $13,334 salary, $1,833 bonus and indirect compensation, $969 expenses and no stock; **M. F. Bagan**, vice president and assistant to the president, $13,000 salary, $1,833 bonus and indirect compensation, $1,713 expenses and no stock; **F. W. Milam**, vice president-transportation, $12,667 salary, no bonus or indirect compensation, $668 expenses and 456 shares of common stock; **J. G. Lombardi**, director, $150 fees, no bonus, indirect compensation, expenses or stock; **W. Jordan**, director, $150 fees, no bonus, indirect compensation or expenses with 100 shares of common stock; **K. W. Dyall**, director, $150 fee, no bonus, indirect compensation, expenses or stock.

Following firms were paid for services rendered during 1959: **Burke, Williams & Sorensen**, legal, $9,181; **Peat, Marwick, Mitchell & Co.**, audit and tax, $6,675.

New York Airways, Inc., (company listed



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ETHIOPIAN AIRLINES

THE WONDERLAND ROUTE

only one bonus and indirect compensation) —**R. L. Cummings, Jr.**, president and director, $22,687 salary, $15,655 expenses and 2,250 shares of common stock; **H. Brock**, vice president and director, $16,703 salary, $994 expenses and 1,250 shares of common stock; **J. E. Gallagher**, vice president, $15,788 salary, $7,160 expenses and 500 shares of common stock; **W. W. Hogan**, vice president and treasurer, $12,269 salary, $1,518 expenses and 550 shares of common stock; **J. H. Slate**, secretary (see compensation paid to firm of Skadden, Arps, Slate & Timbers for services rendered during 1959); **G. B. Eastburn**, vice president, assistant to the president and assistant treasurer, $10,988 salary, $1,248 expenses and 100 shares.

L. G. Gerter, assistant vice president-operations (entered office 12/7/59), $15,753 salary, $128 expenses and no stock; **R. de Haan**, assistant vice president-maintenance (entered office 12/7/59), $11,153 salary, $611 expenses and 500 shares of common stock; **R. Wheatland II**, assistant vice president-traffic and sales (entered office 12/7/59), $9,403 salary, $1,471 expenses and 500 shares of common stock; **G. J. Glynn**, assistant treasurer, $7,864 salary, $104 expenses and no stock; **F. Peters**, assistant secretary, $4,914 salary.

Following directors were not paid expenses: **H. Ammidon**, $350 salary and no stock; **R. E. Blum**, $400 salary and no stock; **R. W. Dowling**, $100 salary and no stock; **F. M. Glass**, $525 salary and 200 shares of common stock; **G. Loening**, $225 salary, $4,706 bonus and indirect compensation and 6,000 shares of common stock; **R. G. Goelet**, $350 salary and 5,000 shares of common stock; **S. C. Park**, $450 salary and no stock; **W. Shields, Jr.**, $450 salary and 200 shares of common stock.

Following firms were paid for services rendered during 1959: **George Daly Associates**, public relations, $12,166; **Information Center**, graphic arts, $11,045; **Lybrand, Ross Brothers and Montgomery**, accounting, $13,537; **Skadden, Arps, Slate and Timbers**, legal, $75,000.

Aloha Airlines, Inc., (company did not pay bonuses or indirect compensations)—**R. F. Tongg**, chairman of the board, (entered office 3/26/59), $13,800 salary, $882 expenses and 231,640 shares of preferred stock; **H. Wo Ching**, president and director (entered office 3/26/59), $27,386 salary, $2,722 expenses, 23,600 shares of common stock and 589,750 shares of preferred stock; **D. A. Benz**, senior vice president and director (entered office 3/26/59), $14,000 salary, $1,537 expenses and 25,000 shares of preferred stock; **K. V. C. Char**, administrative vice president (entered office 4/16/59), $6,833 salary, $729 expenses and 13,000 shares of preferred stock; **C. D. Young**, vice president and treasurer (entered office 3/26/59), $12,800 salary, $1,906 expenses and 23,500 shares of preferred stock.

J. M. Brown, vice president-operations (entered office 6/1/59), $7,540 salary, $587 expenses and 1,000 shares of preferred stock; **W. E. Wood**, vice president-sales (entered office 3/26/59), $12,353 salary, $7,861 expenses and no stock; **P. Economou**, director of flight operations (entered office 5/14/59), $9,048 salary, $517 expenses and 4,500 shares of preferred stock; **H. Wai Ching**, (entered office 3/26/59), director, no salary, $20,000 fee paid for obtaining financial loan of $2,290,000 to purchase new aircraft, 115,500 shares of preferred stock and 61,000 shares of common stock.

Harry A. Bowen was paid $12,064 for legal services rendered during 1959.

Hawaiian Airlines, Ltd., (carrier did not list expenses, bonuses or indirect compensations)—**A. D. Lewis**, president and director, $36,250 salary and director fee, and $11,500 in 6% convertible subordinated debentures; **B. Cooke**, vice president-finance and director (entered office 4/30/59), $22,750 salary and director fee, 50 shares of common stock and $1,900 in 6% convertible subordinated debentures; **L. D. Machado**, vice president-operations and director, $22,750 salary and director fee, 10 shares of common stock and $1,800 in 6% convertible subordinated debentures; **J. C. Tobin**, vice president-sales and director, $22,625 salary and director fee, 125 shares of common stock and $2,500 in 6% convertible subordinated debentures.

L. C. Conant, vice president-industrial relations (entered office 4/30/59), $16,500 salary, 715 shares of common stock and $3,800 in 6% convertible subordinated debentures; **W. M. Crilly**, vice president-planning (entered office 4/30/59), $16,500 salary, no common stock or debentures; **G. K. Tenabe**, treasurer (entered office 4/30/59), $12,869 salary, 100 shares of common stock and $200 in 6% convertible subordinated debentures; **L. P. Irons**, secretary and assistant treasurer, $11,200 salary, no common stock and $300 in 6% convertible subordinated debentures; **I. Matsunaga**, assistant treasurer (entered office 12/1/59), $8,700 salary, no common stock and $200 in 6% convertible subordinated debentures.

Following directors received directors' fees: **S. C. Kennedy**, chairman of the board, $250 fee, 20,773 shares of common stock and no debentures; **H. L. Bair**, $250 fee, no common stock and $100,000 in 6% convertible subordinated debentures; **R. D. Fraser**, $250 fee and no common stock or debentures; **J. M. Greenwell**, $330 fee, 2,000 shares of common stock and $3,000 in 6% convertible subordinated debentures; **Chinn Ho**, $250 fee, 5 shares of common stock and $3,300 in 6% convertible subordinated debentures; **D. C. Lewis**, $350 fee, 1,113 shares of common stock and $1,000 in 6% convertible subordinated debentures; **J. E. Russell**, $250 fee.

S. Takahashi, $250 fee, 750 shares of common stock and $5,000 in 6% convertible subordinated debentures; **W. C. Tsukiyama**, $250 fee, 90 shares of common stock and no debentures; **H. W. B. Whitz**, $370 fee and no common stock or debentures; **G. P. Wilcox**, $250 fee, 3,049 shares of common stock and $1,500 in 6% convertible subordinated debentures; **W. T. Beeks**, $250 fee and no common stock or debentures; **R. J. Behnke**, $250 fee, no common stock and $4,600 in 6% convertible subordinated debentures; **T. H. Smyth**, $250 fee and no common stock or debentures; **H. E. Clements**, $250 fee, 20,350 shares of common stock and no debentures; **R. S. Odell**, $250 fee, no common stock and $100,000 in 6% convertible subordinated debentures; **H. F. Heep**, $167 fee, no common stock and $328,000 in 6% convertible subordinated debentures.

Following firms were paid for services rendered during 1959: **Pogue & Neal**, legal, $11,842; **Stanley H. Brewer**, air cargo traffic consultant in Trans-Pacific Case, $7,000; **John O. Child & Co.**, Pacific area economist in Trans-Pacific Case, $7,164; **L. G. Fritz**, operations consultant in Trans-Pacific Case, $8,277; **Turney & Turney**, legal services in Trans-Pacific Case, $37,025; **Selig Altschul**, financial consultant in Trans-Pacific Case, $7,531; **Gotch & Crawford**, air transport consultant in Trans-Pacific Case, $10,694; **Evans, McLaren, Lane, Powell & Beeks**, legal services in Trans-Pacific Case, $5,176; **Lewis, Buck and Saunders**, legal services, $12,087; **Holst & Male**, advertising services, $26,579.

Mackey Airlines, Inc., (carrier did not list bonuses, indirect compensation or expenses)—**J. C. Mackey**, president, $15,000 salary and 115,734 shares of common stock; **J. H. Popham**, vice president and treasurer, $13,000 salary and 10,001 shares of common.

Following firms were paid for services rendered during 1959: **Adair, Ulmer, Murchison, Kent & Ashby**, legal, $9,501.63; **G. Sayward & Associates**, advertising, $45,826.57.

Resort Airlines, Inc.—**M. M. Townsend**, president and director, $15,000 salary, no bonus or indirect compensation, $3,000 expenses and no stock; **T. B. Wilson**, chairman of the board, $15,000 salary, $9,214 bonus and indirect compensation, $3,000 expenses and no stock; **D. P. Larsen**, vice president, $15,000 salary, $9,214 bonus and indirect compensation, $3,000 expenses and no stock; **Van Buren Nixon**, vice president, $12,000 salary, $9,214 bonus and indirect compensation, $3,000 expenses and no stock; **J. F. Murray**, vice president and director, $13,200 salary, $9,214 bonus and indirect compensation, $3,000 expenses and no stock; **R. E. Hartz**, vice president, $1,200 salary, no bonus, indirect compensation, expenses or stock; **C. Davidson**, treasurer and director, $8,100 salary, $9,214 bonus and indirect compensation, $1,500 expenses, 35 shares of common stock and 8 shares of common stock in name of others; **J. P. Simpson**, secretary, $7,350 salary, no bonus, indirect compensation, expenses or stock; **C. J. Running**, assistant secretary, $6,688 salary, no bonus, indirect compensation, expenses or stock.

Following firms were paid for services rendered during 1959: **Lybrand, Ross Brothers & Montgomery**, audit fee, $8,500; **Koteen & Burt**, legal fee, $25,002; **Stevenson, Paul, Rifkind, Wharton & Garrison**, professional services, $8,291.

Carribbean Atlantic Airlines, Inc.—**D. Trigo**, president and director, $20,000 salary, $5,000 bonus and indirect compensation, $3,972.87 expenses and 18,221 shares of common stock; **B. Trigo**, vice president and director, $10,000 salary, no bonus, indirect compensation or expenses and 18,221 shares of common stock; **J. M. Sierra**, vice president-operations and director, $16,050 salary, $2,000 bonus and indirect compensation, $2,760.39 expenses and 208 shares of common stock; **R. B. Forrest**, vice president-traffic and director, $10,225 salary, $1,000 bonus and indirect compensation, $2,551.10 expenses and 4 shares of common stock.

L. A. Lockhart, treasurer and director, $9,600 salary, $1,000 bonus and indirect compensation, $336.50 expenses and 260 shares of common stock; **A. Valdes**, secretary and director, 80 shares of common.

Following directors were not paid a salary, bonus, indirect compensation or expenses: **F. A. Fernandez**, 869 shares of common stock; **J. Trigo**, 11,890 shares of common stock; **D. V. Borns**, 150 shares of common stock; **I. Paiewonsky**, no stock; **F. Ballester**, 435 shares of common stock.

Whiteford, Hart, Carmody & Wilson were paid $14,590.83 for legal services.

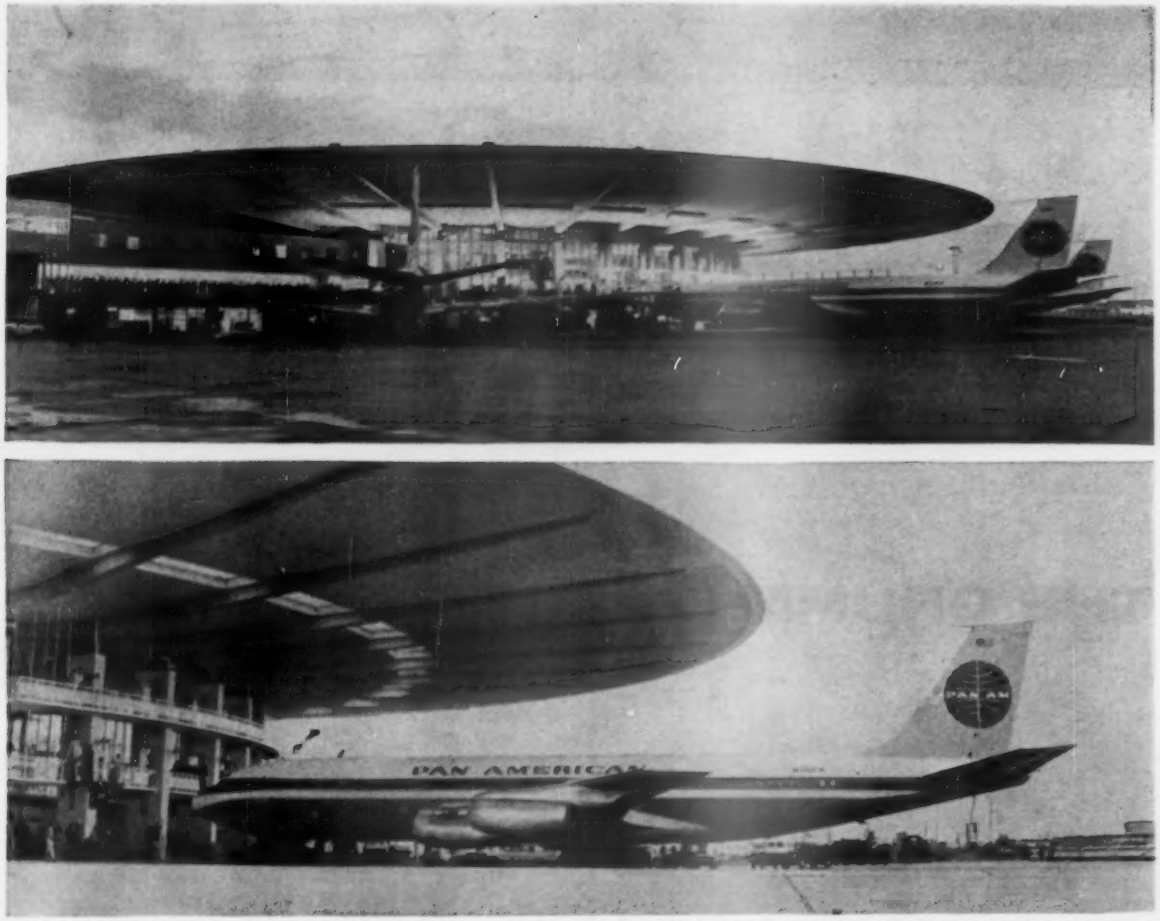
Pan American-Grace Airways, Inc., (carrier did not list stock holdings)—**A. B. Shea**, president and director (also officer of W. R. Grace & Co.), no salary, bonus or indirect compensation and $1,634 expenses; **E. Balluder**, vice president and director (also officer of Pan American World Airways), no salary, bonus, indirect compensation or expenses; **E. L. Farrell, Jr.**, vice president and director (also officer of W. R. Grace & Co.), no salary, bonus, indirect compensation and $1,347 expenses; **D. Campbell**, vice president and general manager, $26,500 salary, $4,300 bonus and indirect compensation and $4,149 expenses; **T. J. Kirkland**, vice president, $26,500 salary, $3,300 bonus and indirect compensation and $4,806 expenses.

L. H. Clifton, vice president and comptroller, $22,500 salary, $2,000 bonus and indirect compensation and $2,965 expenses; **C. S. Collins**, vice president, $19,500 salary, $1,700 bonus and indirect compensation and $6,768 expenses; **J. T. Scholtz**, assistant vice president, $18,500 salary, $900 bonus and indirect compensation and $1,278 expenses; **M. de Murias**, assistant vice president, $13,500 salary, $600 bonus and indirect compensation and $4,258 expenses; **R. V. Rowe**, assistant vice president (also officer of W. R. Grace & Co.), no salary, bonus, indirect compensation and $3,424 expenses; **G. M. Oxley**, secretary (also an officer of W. R. Grace & Co.), no salary, bonus, indirect compensation or expenses; **J. S. Woodbridge**, treasurer (also an officer of Pan American World Airways), no salary, bonus, indirect compensation or expenses; **H. P. Morris**, assistant secretary (also an officer of Pan American World Airways), no compensation.

A. J. Phelan, assistant comptroller, $15,500 salary, $650 bonus and indirect compensation and $1,365 expenses; **W. F. Lewis**, assistant treasurer, $14,000 salary, $400 bonus and indirect compensation and $1,666 expenses; **E. E. Spencer**, assistant treasurer, $12,500 salary, $400 bonus and indirect compensation and $4,608 expenses.

Following directors were not paid a salary, bonus, indirect compensation or expenses and are officers of either Pan American World Airways or W. R. Grace & Co.: **H. J. Friendly** (resigned 9/30/59), **W. L. Morrison, F. E. Larkin, B. Lewis and K. A. Lawder.**

Following firms were paid for services rendered during 1959: **Covington & Burling**, (from 7/1/58 to 6/30/59), legal, $55,831; **Reid & Priest**, legal, $12,436; **White & Case**, legal, $36,610; **S. Kipp Farrington**, sales promotion, $14,023; **Price Waterhouse & Co.**, accounting, (years 1958 and 1959), $12,510.

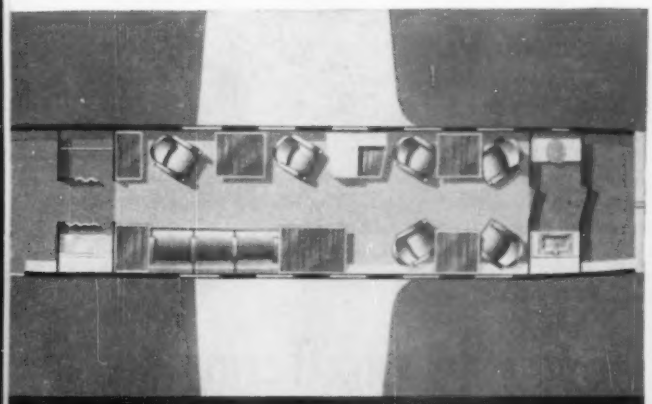


Pan American World Airways last week opened its passenger terminal at New York International Airport. The terminal can accommodate six jet transports simultaneously under its cantilevered roof which juts 114 ft. from the glass walls of the elliptical building. The roof's outer edge is 50 ft. above ground. Two extra positions for aircraft are available and there is expansion space for more if needed. Passengers travel between the aircraft cabin and the terminal via adjustable walkways. The $12 million building can handle eight 120-passenger aircraft per hour. The terminal has an 89 ft. x 10 ft. air curtain at the main entrance.

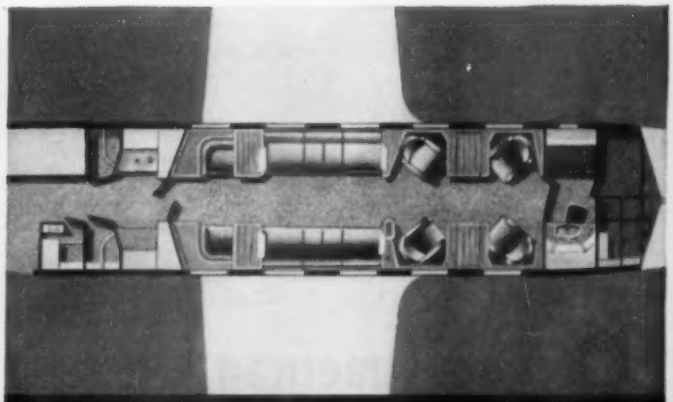
PanAm, American Operate New Idlewild Terminals

American Airlines now handles 10 jet transport departures daily from its $14 million terminal building at New York International Airport, and about 2,000 outgoing passengers on all types of equipment. The building opened earlier this year. View from street side shows 317-ft.-long display of multi-colored stained glass. American says the terminal can handle 15 jet transports simultaneously.

THE GRUMMAN "GULFSTREAM"



Picked by an Oil Company



Selected by a Steel Company

Isn't this

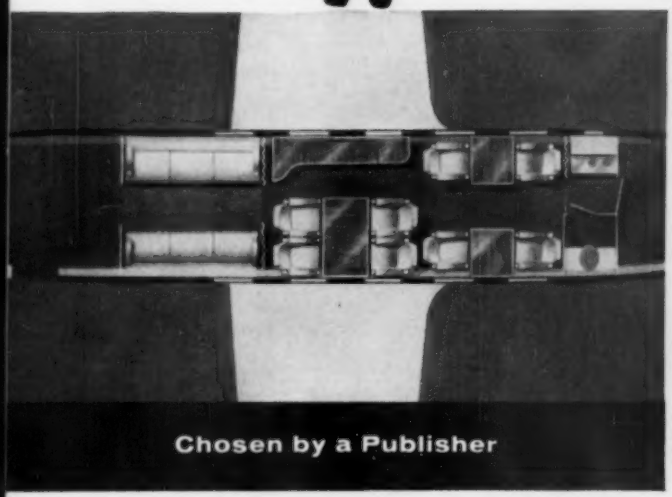
The Business Aircraft

for your Company, too?

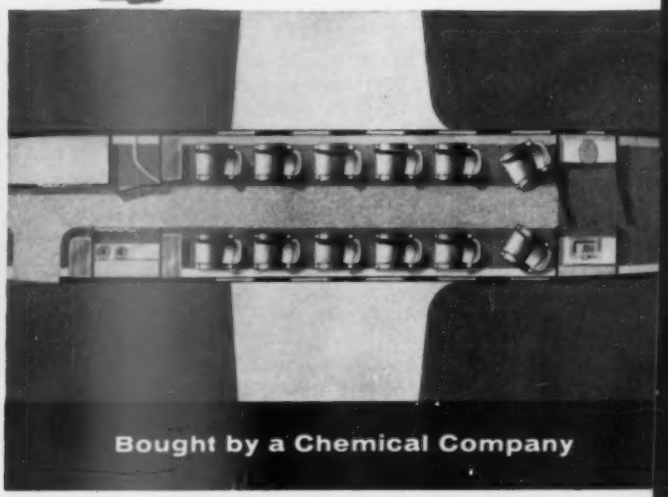
The cutaway views above show interior layouts selected by four different purchasers of the Gulfstream. Each interior has been designed and fitted out to individual specification.

Many leading American companies have selected the exceptional Gulfstream over all other business aircraft on the market. Thirty-six are already operating in different parts of the country.

The Gulfstream will carry 10, 12 and 14 passengers. You will cruise at 350 mph. Power: 2 superb Rolls-Royce Dart engines. You have a range of 2,200 miles, plus reserves of 200 miles



Chosen by a Publisher



Bought by a Chemical Company

and 45 minutes. And the Gulfstream has what some aircraft in its class *haven't*—the ability to get in and out of the smaller airports with ease . . . those with 3,500-4,000 foot runways.

At 25,000 feet, the pressurized Gulfstream provides a cabin altitude of 5,500 feet. You fly in air-conditioned comfort—and safety—above the weather and traffic.

To date, Grumman has built 25,000 aircraft. This experience is aboard the Gulfstream. And Grumman engineering provides a structure designed to withstand fatigue for the equivalent of more than 50 years of operation! Performance, utility, reliability, safety? Of course. And great beauty, too.

The Grumman Gulfstream is an extraordinary business transport. We think your executives will agree with your chief pilot's evaluation of the aircraft when our distributor demonstrates its many outstanding features.

Corporation executives and pilots are invited to inspect the Gulfstream and arrange for demonstration flights through one of the following distributors: Atlantic Aviation, Wilmington, Delaware; Pacific Airmotive, Burbank, Cal.; Southwest Airmotive, Dallas, Texas; Timmins Aviation, Montreal.

Aboard the GULFSTREAM, Beauty is more than skin deep!

GRUMMAN

AIRCRAFT ENGINEERING CORPORATION

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AIRLINE OBSERVER

▶State Department now feels that Soviet Russia will accept a recent U. S. invitation (AW May 2, p. 25) to begin talks July 18 on a bilateral air transport agreement. Although no official word of acceptance had been received late last week, State officials are interpreting a statement made last month at a press conference by Gen. Yeugeni Loginov, chief of Aeroflot, the Russian airline, as a typically indirect but affirmative response to the U. S. invitation. Gen. Loginov said the two governments will meet in New York on the date suggested by the U. S. When negotiations begin, U. S. delegation will be headed by Edward Bolster, who replaces Laurence C. Vass June 19 as director of the Office of Transport and Communications.

▶Aeroflot is testing a long-haul, 78-seat version of its turboprop Il-18 transport. New configuration has a third passenger compartment in the tail with eight sleeper seats. To make room for this extra compartment, a coat closet and one lavatory were moved forward to the area which absorbs the most propeller noise. Front passenger compartment in the new version has 20 seats, and the main compartment 50 seats. Another version of the Il-18—designed to carry 125 passengers in short-haul operation—is under development.

▶Failure of front rotor bearing on Rolls-Royce Conway engines has caused in-flight engine shutdowns on recent flights of Boeing 707-420 transports. Air India has had two shutdowns, Lufthansa one and Boeing Airplane Co. one to date. Rolls-Royce is conducting a crash program to find a fix for the bearing. Failure allows front of rotor to wobble inside casing causing substantial damage.

▶Iberia Air Lines of Spain may turn to the de Havilland Comet 4 to fill out its turbojet equipment requirements, even though France's Sud Caravelle turbojet transport is the carrier's first choice. Iberia officials say the Caravelle is best suited for the airline's European routes, but the company lacks the funds to make required payments on the fleet of four Caravelles it wants. De Havilland reportedly is ready to offer Iberia the credit it needs to make a purchase, while Sud Aviation has not yet indicated it will provide credit or long-term payments on a Caravelle order.

▶Delta Air Lines has filed a formal complaint with the Civil Aeronautics Board accusing Eastern Air Lines of "unfair, misleading and deceptive" advertising practices with its DC-8 service. Delta has charged that Eastern is advertising its DC-8 service by designating the airplane as a DC-8B, although "there is not in fact any such aircraft." Delta said Federal Aviation Agency has officially designated the DC-8 powered by Pratt & Whitney J57 engines, flown by Delta, as the DC-8-11 and the same transport powered with Pratt & Whitney J75 engines, flown by Eastern, the DC-8-21.

▶Export-Import Bank of Washington will offer guarantees to exporters against losses due to political risks in conjunction with guarantees already available on the usual credit risks. Political risks include inability of buyer to obtain U. S. dollars at his bank abroad, cancellation of an import license, war, laws or regulations which prevent delivery of goods and expropriation of exported items by foreign authorities.

▶Aeroflot has opened a downtown ticket office in Cairo near the Nile Hilton Hotel. It is the first such ticket office to be operated by the Russian carrier in the Middle East. Aeroflot has a regular weekly service between Cairo and Moscow using Il-18 turboprop transports.

▶Investment climate for airlines has undergone a quiet change for the better during the last few weeks. Several major firms feel airline stocks probably hit bottom in April and now are ready to turn upward. Opinion, however, is still cautious. One brokerage house said in its quarterly review that the lows of airline listings had been passed but made no forecast. No one expects rapid recovery. One veteran market analyst pointed out that, historically, after a long decline in a group, there is a period of accumulation with prices moving sidewise. Better earnings and evidence of a more favorable regulatory attitude will be necessary to spur any major advance, and these prospects are not viewed as likely to mature until next year.

SHORTLINES

▶**Air France** reports its fleet of Sud Aviation Caravelle turbojet transports has carried 223,648 passengers and flown 141,260,625 revenue passenger miles during the first 11 months of operation, ending Mar. 31. The French airline also reported the Caravelle maintained a 66% load factor during off-season winter months and achieved a 93% on-time record for the 11 month period.

▶**Alitalia** has received a 90 day extension of its temporary foreign air carrier permit authorizing the airline to operate to the U.S. pending conclusion of bilateral talks between the U. S. and Italian governments. The permit was to expire May 29. Alitalia seeks additional service to Montreal and Europe.

▶**Bonanza Air Lines** has added two Fairchild F-27 turboprop aircraft to its fleet and says F-27s now fly nearly 90% of the company's schedules.

▶**Civil Aeronautics Board** has revoked the permit of Universal Air Freight Corp., an air freight forwarder, effective June 12. Board said Universal has not engaged in forwarding for the past two years and was issued a notice of intent to cancel its operating authorization on Apr. 23, 1959. Board said the company did not operate as an air freight forwarder during 1959.

▶**Los Angeles International Airport** handled 1,437,684 passengers during the first quarter of 1960, a 19.31% increase over the same period last year. The number of air carrier movements decreased by 2,365, and the airport reported that daily turbojet takeoffs now number 50.

▶**Pan American World Airways** reports that during the first four months of 1960, travel on the carrier's routes has increased 21% over the corresponding period last year. Largest percentage gain was on the polar route between the West Coast and Europe, where traffic rose 158%. Other gains on the carrier's routes were: West Coast-Hawaii traffic, 72%; round-the-world service, 61%; Pacific area operations, 59%; transatlantic traffic, 16% and Latin American service, 6%.

▶**Trans World Airlines** and Railway Express Agency have signed an agreement calling for shipment of cargo to and from non-airport points by surface travel. Shipments may be originated as air freight and delivered as surface express, or vice versa.

New space-scanning radio telescope equipped with *Styroflex® Coaxial Cable*

Styroflex® coaxial cable is an important component part of the new radio telescope now in operation at the National Radio Astronomy Observatory, Green Bank, W. Va. This remarkable telescope is designed to probe the universe for radio waves originating in space.

Six "runs" of Styroflex® coaxial cable connect the 85-foot parabolic antenna with the control building. These "runs" are used to relay radio waves picked up from outer space by the telescope.

The job of feeding these low-energy radio waves to the control center calls for a high frequency cable with a low inherent noise level. The low loss and low noise to high signal ratio of Styroflex® cable provide the ideal answer to these operational requirements. An additional advantage is the long operating life of this coaxial cable, regardless of climatic conditions.

The superior properties of Styroflex® cable have earned for it an outstanding reputation in high frequency cable applications of many different kinds. If you have a problem requiring the use of a high frequency cable with exceptional characteristics, perhaps Styroflex® can provide the answer.

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Three generations of ARMA computers:
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Package small...guidance true

The itinerant bee has nature's simplest yet most advanced guidance system. His built-in computational abilities—certainly his miniaturization—haven't yet been approached by man.

ARMA, however, is showing the way. A six-year computer miniaturization program, completely company-funded, is producing a family of progressively smaller and more sophisticated computers for use in man-made guidance systems. Here is the result thus far in this continuing program.

Small: ARMA's operational computer, now in use in inertial guidance systems, employing all semi-conductor circuitry, printed wiring techniques and conventional logical design organization.

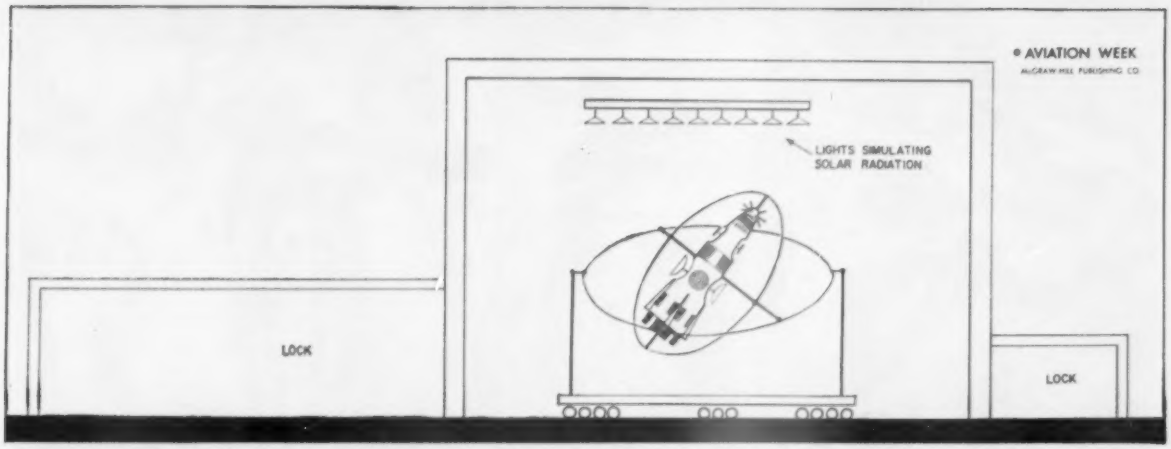
Smaller: a second-generation computer ...all-solid state, with no moving parts, applicable to *all* types of navigation, embodying 1/4 the volume, 1/3 the weight and 1/15 the power requirements of its predecessor.

Still Smaller: the third member of the family. This microminiature computer, to be completed in 1961 from components now in existence, will be 1/25 the volume and 1/10 the weight of the first-generation model while performing the same guidance and control computations. It will have application in missile guidance, space navigation and guidance, orbit transfer problems, submarine navigation and periscope stabilization. The reliability of this sophisticated product will be assured by thorough testing in ARMA's environmental facilities—most complete in the industry.

ARMA, Garden City, N.Y., a division of American Bosch Arma Corporation . . . supplier of precision inertial guidance systems for long range Air Force missiles . . . the future is our business.

Attention Engineers: Write to E. C. Lester at ARMA about career openings in R & D programs.

AMERICAN BOSCH ARMA CORPORATION



SCHEMATIC version of planned space environment facility's general features includes full-scale space vehicle mounted on support system which would afford freedom of motion. Walls of main chamber, which would measure about 200 ft. in diameter, by 150 ft. high, would accommodate refrigerant for low-temperature characteristics. System of locks would facilitate preparation of test space vehicles, operation of ion and nuclear engines, and implementation of safety provisions.

AEDC Plans Space Environment Chamber

Tullahoma, Tenn.—Response of full-scale space vehicles, components and engines will be evaluated under realistic physical conditions in a huge environmental chamber planned by the Air Force for its Air Research and Development Command's Arnold Engineering Development Center here. This probably will be the largest and most extensively instrumented chamber of this type in the world.

The facility will eliminate considerable design and operational guesswork in hardware for manned space missions, will supply an on-earth study capability to minimize hazards and preview space vehicle problems associated with out-of-atmosphere travel.

Rigid Requirements

No detailed specifications for the facility have been formulated yet, but the over-all characteristics of the environmental chamber and its associated support and monitoring equipment have been established generally to indicate the rigid requirements involved for realistic checkout.

With immediate implementation, it is unlikely that the full-scale space environment facility could be readied before three years. To fill the gap, two 7-ft. x 30-ft. pilot chambers are being built at AEDC and probably will be available for operation within a year. A research program also is being pushed concurrently to solve some of the problems involved in design and operation of the full-scale environment chamber.

Living subjects—animals and humans—will be included in the space environment chamber experiments, being fed into the program with progressive degrees of participation governed by safety considerations.

Tests of ion engines operating under space conditions will be feasible in the chamber, and the facility will be designed specifically to accommodate this type of research, but massive exhausts will not permit checking of conventional rocket engines without destroying the realistic vacuum capability of the chamber. Except for ion engine exhaust temperatures and the normal difficulties associated with very high vacuum, existing techniques should be able to handle the requirements of the space environment chamber.

Operation of nuclear engines also will be feasible. The chamber's main vehicle lock will be lined with radiation shielding in the area where it joins the space environment chamber. By blocking off the southside portion of the lock with a door, it will be possible to accommodate the reactor in the lock during engine operation. The space environment chamber also will have shielding to prevent radiation to its interior.

Materials will constitute another area of investigation in the chamber, for determining their behavior under critical out-of-atmosphere conditions.

Comprehensive support and data-gathering installations will function to ensure maximum safety and return of information for precise control of chamber operational parameters. Instrumentation specially designed to fit the extreme environments of the facility will be required.

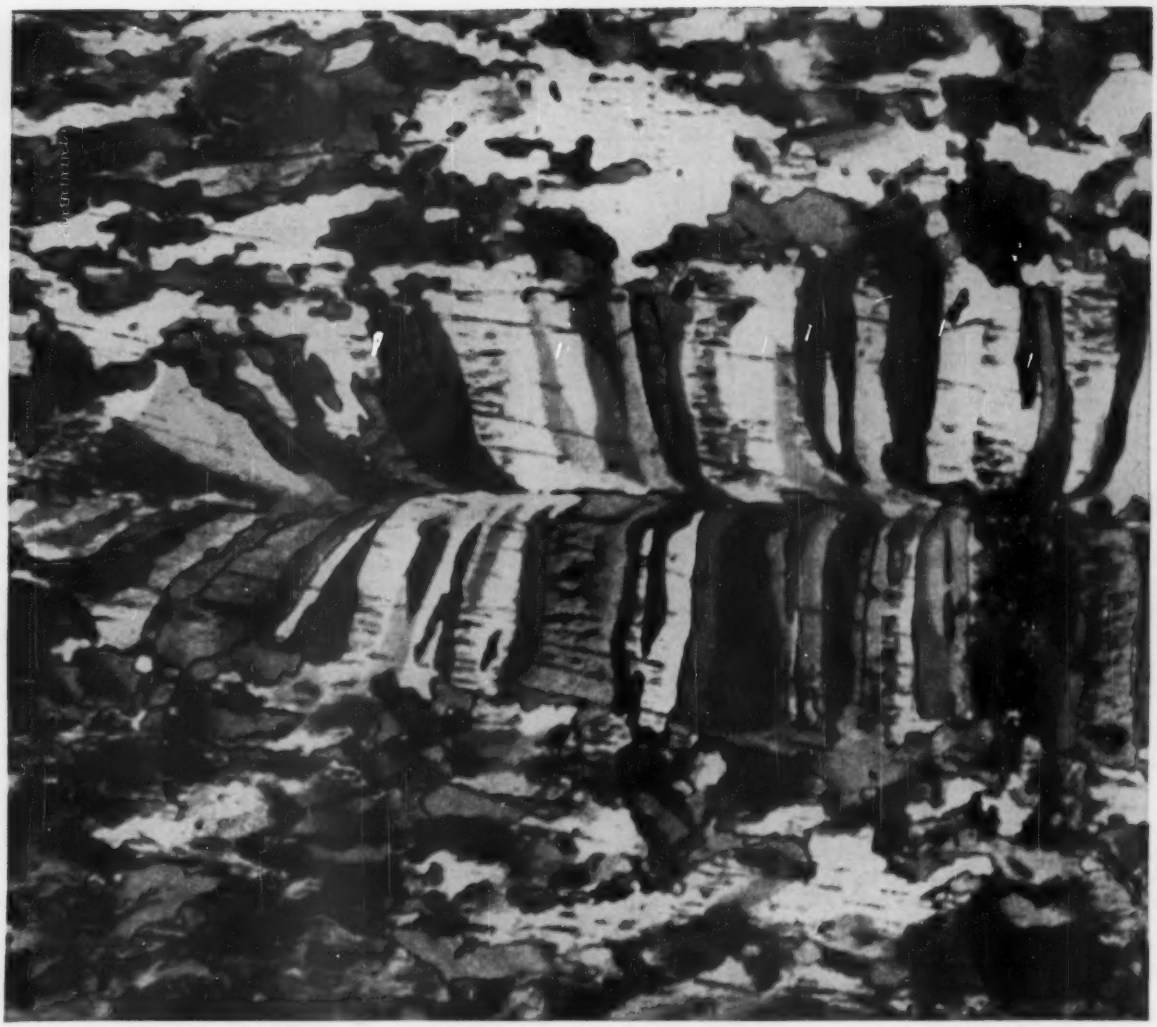
Facility Features

Projections for the environmental facility includes these features:

- **Configuration** of the space environmental facility is projected as a cylindrical structure approximately 200 ft. in diameter and about 150 ft. high.
- **Pressure in the chamber** is expected to span on operating range of 10^{-8} (.001) to 10^{-11} (.00000000001) mm. hhg. This would be done with a combination of roughing and backing pumps, in combination with diffusion pumps for removing non-condensable gases, and a low-temperature pumping system (20K) for condensable gases.
- **Heat sink with low-temperature** and no-emissivity characteristics will line the chamber completely and be refrigerated to a steady temperature of 100K.
- **Simulated solar radiation** supplying

Space Chamber Values

Characteristics	Range
Pressure	10^{-3} to 10^{-11} mm. Hg.
Temperature	4K to 2,000K
Solar Radiation	1,400 watts/sq. meter
Thermal Radiation	to 200 kw.
Acceleration	10^{-4} to 80g
Shock	50 to 200g
Atmosphere	H, N, O
Meteoric Particles or Dust Particles	Molecular to 10 Gm. and 100 to 10^{5} meters/sec.



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This photomicrograph is visual proof that beryllium can be resistance welded. Extensive tests at the Budd Company indicate useful sheet metal products can be fabricated from beryllium. Work with beryllium at Budd includes successful hot rolling, brake forming, deep drawing, brazing, resistance welding, arc spot welding, arc welding, cleaning, machining and hot shearing.

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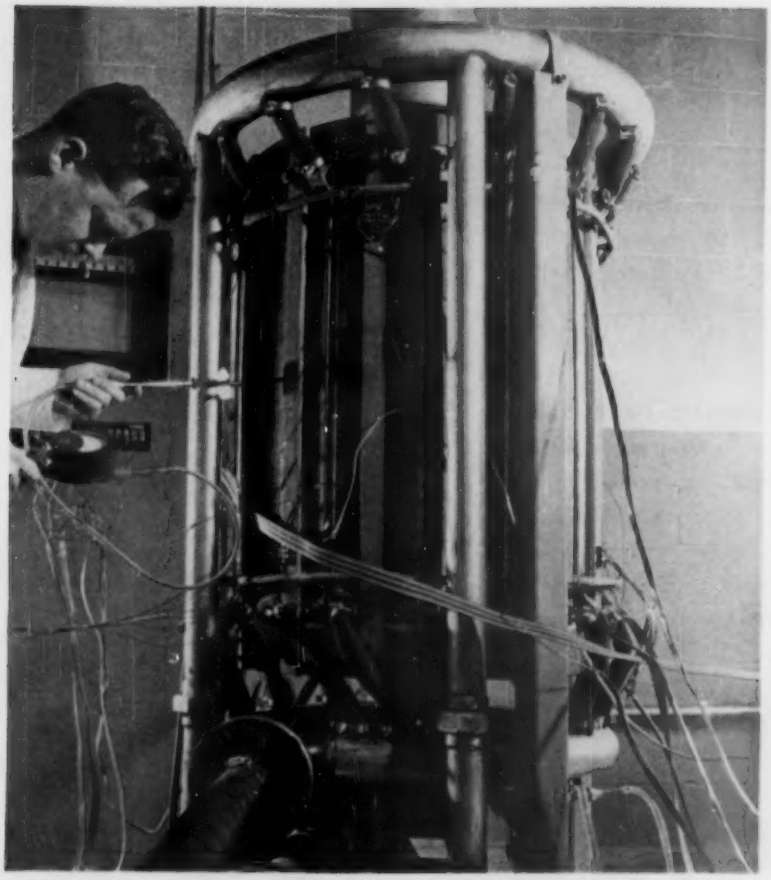
SPACEATOMICS Budd DIVISION



Westinghouse Tests Thermoelectric Generator

Largest thermoelectric generator ever produced, capable of supplying 5,000 watts of electric power by direct conversion of heat into electricity, has undergone full power tests at Westinghouse Electric which developed generator under Navy contract. Element shown above is a 2,500 watt sub-generator, two of which form complete unit. Generator burns kerosene and operates at a temperature of 1,200F. Only moving parts are pumps for cooling water and for fuel burners. Six different types of thermoelectric materials are employed, including both broad and narrow-band semiconductors.

1,400 watts per square meter will be afforded by a mobile bank of incandescent and gaseous-discharge lamps over the wide test area.

• **Reflected solar radiation** (albedo) will be simulated by a battery of fluorescent lamps. Infrared radiation will be simulated by a bank of heaters.

• **Wide variety of full-scale** space vehicles will be able to be accommodated on a mobile support system rack which will afford the vehicle freedom of motion. A large mobile crane will facilitate handling the vehicle in the chamber.

• **System of locks** will supplement the space environment chamber. A main airlock, approximately 150 ft. long and 50 ft. in diameter will serve the test vehicle while it is being mounted on its support system, and during instrumentation, checkout and calibration. This lock will be degassed by pumps before the support system carrying the vehicle is rolled into the space environmental chamber.

A second lock, about 50 ft. long and 30 ft. in diameter, on the other side of the chamber, fitted with diffusion pumps, low-temperature plates, and baffles to catch carbon products emanating from electrodes, will be used to take in the discharge from an ion engine under test.

Another lock will accommodate facility personnel dressed in space suits to enter the chamber for maintenance, adjustment, and checkout of vehicles or components under test. Rescue and first aid locks will be manned and alerted for any emergency within the chamber, which might endanger working personnel.

In addition to pressurized rescue locks, transporters also will be used to provide mobility for the life-support services. To ensure highest safety, it is likely that a "buddy" system will be

certain.

MAJOR MERGER IN SWITCH INDUSTRY

Controls Company of America Merges Hetherington Div. With Electrosnap Corp. to form New Control Switch Division.

One of the precision switch industry's most complete product lines has come into existence with the announcement by Louis Putze, President of Controls Company of America, Schiller Park, Ill., that its subsidiary Hetherington, Inc., has been merged with Electrosnap Corporation, Chicago. The Electrosnap organization was recently merged with Controls Company of America

"This merger is important to witch users", Mr. Putze stated cause it co

WHAT'S IN IT FOR YOU?

You may now select from the industry's most versatile and complete line of precision snap-action switches, indicator lights, push-button switches, toggle switches, Switchlites, and environment-free limit switches. You can now make broader product groupings for greater quantity discounts. With this new single source, you will now deal with just one sales engineer for all your switch needs.

Three plant locations—Folcroft, Pa., Chicago, Ill., and El Segundo, Calif.—will provide regional engineering and manufacturing facilities to speed delivery and service.

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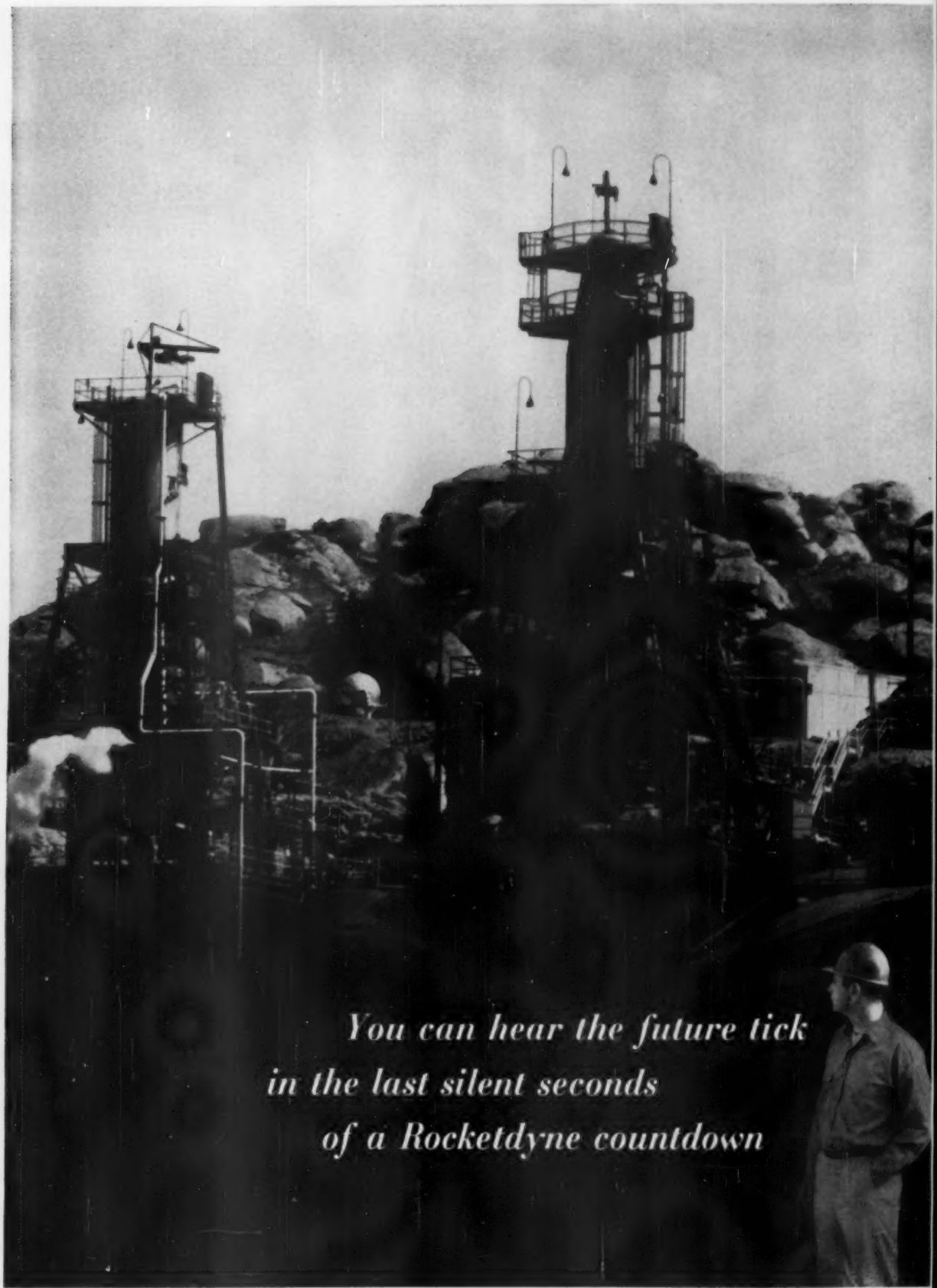
You can hear the future tick
in the last silent seconds
of a Rocketdyne countdown

FOUR...THREE...TWO...ONE... a moment of silence. Then a giant speaks—and a bolt of man-made lightning flashes.

Nearly every hour of every day, Rocketdyne technicians near that dramatic moment as they test and tune the space engines of today.

The best-equipped test facilities for high thrust rocket engines in the nation are at their command. Rocketdyne's finely instrumented test structures are located in California's Santa Susana Mountains; Neosho, Missouri, and McGregor, Texas.

Rocketdyne engines have powered most of the military and scientific projects conducted by the Air Force, Army, and NASA. Now huge boosters of one and a half million pounds of thrust are emerging from the technical heritage of Atlas, Thor, Jupiter, and Redstone.

And even while today's countdowns go on, plans for tomorrow's assault on space are being made. At Rocketdyne, engineers and scientists are investigating such advanced forms of propulsion as ion engines, nuclear engines, plasma jets, and magnetohydrodynamic engines. Meanwhile other groups are at work on high-energy liquid and solid propellants, and dramatic new devices for both liquid and solid propulsion systems.

Rocketdyne, a 12-year pioneer in rocket technology, was first with power for America's long-range ballistic missiles—first with power for Outer Space.

MEGABOOM—a giant solid propellant rocket motor produced at Rocketdyne's McGregor, Texas, solid fuel facility—delivers 100,000 pounds of thrust, boosts test sled to 1,200 mph.

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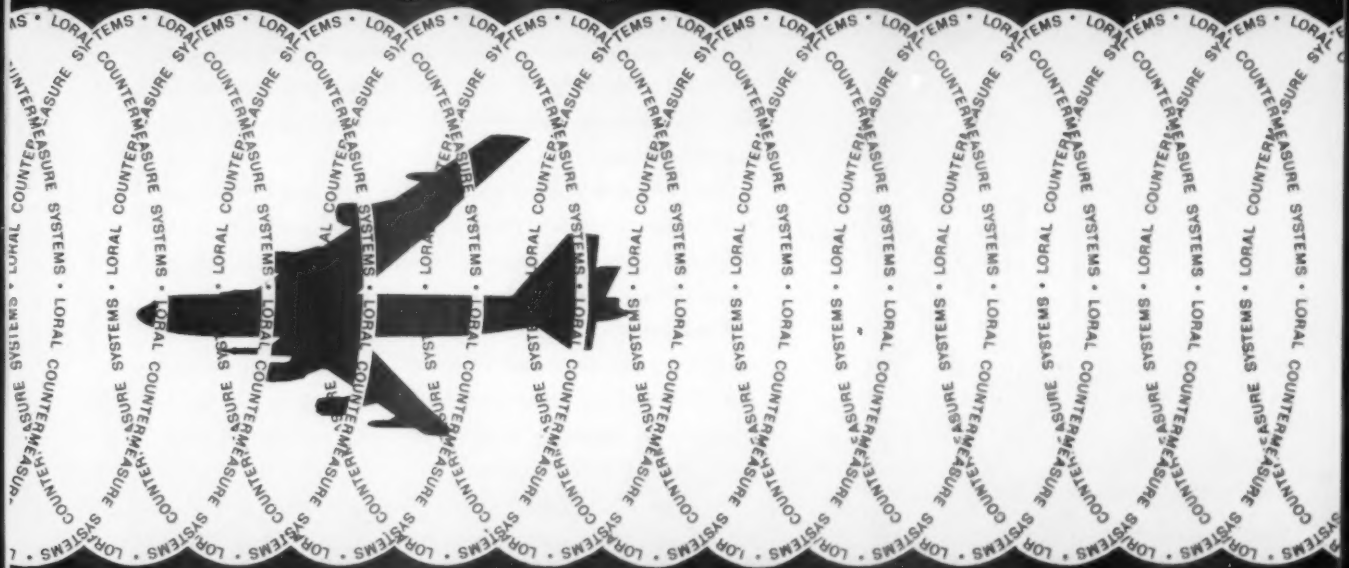
Canoga Park, California; Neosho, Missouri; McGregor, Texas



DEFENDING THE BOMBER:
LORAL COUNTERMEASURE SYSTEMS

LORAL

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Washington, D. C. • Dayton, Ohio • Tustin, Calif. • Designers and producers of electronic aids; also systems for anti-submarine warfare, airborne early warning, navigation, reconnaissance, countermeasures, and passive detection.

used to provide at least two workers for any team in the space chamber, the rescue locks, and in chamber control centers.

An elaborate complement of auxiliary subsystems will be tied in with the main space environment chamber. These will include the following provisions:

• **For gas dynamic tests** of small vehicles, or scale models of larger vehicles, the facility will use a low-density hypersonic wind tunnel feeding into the full-scale environment space chamber through an opening about 10 ft. square. This tunnel facility will use the radio frequency ionization of the gas medium, such as nitrogen, oxygen, argon, and carbon dioxide, simulating the atmospheres of planets such as Earth, Venus, and Mars, accelerating the gas electromagnetically to the extreme velocities required. Pressures reached in the space environment chamber during tunnel runs will depend on the capacity of the pumps for evacuating the chamber, as well as on the mass flow.

• **Guidance system simulation** will be provided for the space vehicle in the environment chamber if it is feasible to include the guidance system along with the vehicle, to subject it to the same forces, moments and attitude changes. Probability is, however, that the guidance system will be housed in a separate test chamber supplementing the main environment chamber. Guidance or control system components would be supported on a gimbaled table, and will experience the same pressures, temperatures and oscillations existing within the space vehicle, because sensors and attitude controls will be supported in the chamber and experience the same environment. A computer will calculate the vehicle's dynamic response to the control inputs, and these corresponding vehicle responses will be fed to the guidance system components. Outputs of these guidance system components will be fed to a computer to compare them with programed or manual inputs. These outputs also could function as signals for movement of force-generators for attitude correction, or for the acutation of signal sources.

• **Observation and communication** system. The space chamber will be under constant visual observation, in addition to continuous monitoring on a television screen. Test and maintenance personnel within the chamber will have communication with control center stations for normal conversation and to institute immediate action in the event of an emergency.

• **Vibration and shock equipment** will include electromagnetic shakers on the space vehicle support system, with some of this equipment probably installed within the vehicle itself.

• **Sound-generating equipment** will be contained within the space vehicle and

Aerotec BB-201 Flow Indicator

• *Actuates on decreasing fuel flow*

• *Discriminates between fuel and air*

Decreasing fuel flow will actuate this valve even though air is mixed in the stream. Installed in the fuel line between auxiliary and main tank in the Lockheed C-130B *Hercules*, this sophisticated unit gives the pilot positive indication when the tank empties, although the fuel pump may draw sufficient air through the line to prevent a conventional switch from functioning. The ability of the BB-201 to discriminate also makes it suitable for applications where gas flow in a liquid-gas mixture is to be monitored.

The indicator has a 5 amp 28 VDC capacity which permits automatic operation of pumps or control valves without relays. Phone or write Aerotec for more information about the BB-201 and other aircraft switches and controls.

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- 5-character alphabetical address, providing over 11 million private addresses;
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Detailed information on request.

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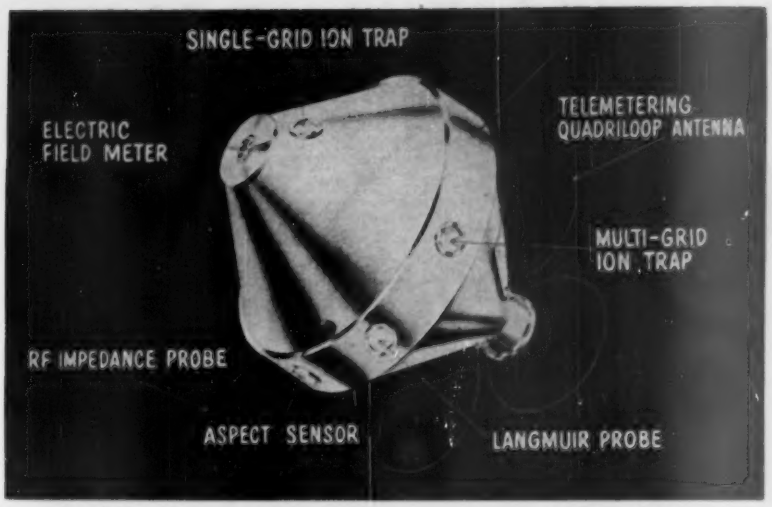


NASA Ionospheric Measurement Satellite

Ionospheric direct measurement satellite S-30, which National Aeronautics and Space Administration will launch this fall with a Juno II booster, will measure electron density, gradient and ion density. Payload also will include a micrometeorite experiment. Also scheduled for this fall is P-14 interplanetary probe to measure magnetic fields.

also within the separate guidance system test chamber, to produce decibel levels to simulate that generated by various phases of space vehicle operation.

• **X-ray and radioactive** source generators will be installed in the space environment chamber for targeting low-level ionizing radiation onto the test vehicle.

• **Magnetic coils** will surround the test vehicle to provide fields similar to those which might be encountered by the vehicle in its space mission.

The space environment chamber and its auxiliary subsystem installations will require an extensive system of monitoring and control. The various control centers are projected to include these basic facilities:

• **Main control center.** This station will have surveillance of the complete facility, including the space vehicle under test, animal or human test subjects, and maintenance personnel inside the chamber. In effect a command post, the center will include a complete complement of instrumentation, signal systems, plotters, communication system, and television monitors. It will also coordinate and monitor the services of auxiliary control centers and total safety provisions for personnel.

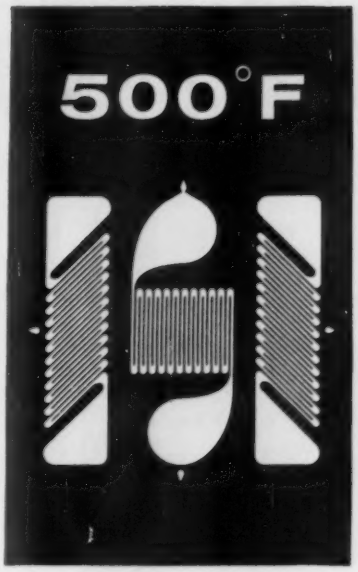
• **Radiation control center.** This station will control characteristics of planetary reflected solar radiation, radiation of the planet itself. It will also control the X-ray system and isotope and proton gun packages. Also controlled and monitored from this station will be solar radiation effects and spectral characteristics.

• **Biological control center.** Animal or human subjects in the test space vehicle will have their actions monitored by this post. For this function the center will be able to control the vehicle's internal pressures and temperatures, decibel levels, vibration and shock characteristics and evacuation action for open ecological systems. Also installed will be psychological and physiological test controls. Physiological data collected will include measurements of respiration, heart and brain action, body temperature and blood pressure. The subject's physical capabilities with respect to sight, hearing and response time also will be noted and charted here. Psychological information collected will depend upon communications and visual and television observation of the subjects.

• **Propulsion systems control** center. Nuclear engines, reactors, ion engines, and auxiliary power source systems will be controlled from this station. Also monitored here will be thrust levels, temperature and pressure values, mass flows, neutron flux values, and radiation levels.

• **Guidance system center.** In addition to housing guidance system environmental controls, analog and digital computers to simulate characteristics of the vehicle, analog equipment for introducing perturbations into the guidance system, this station also will control reference sources which will include radio frequency energy, infrared temperature and source-positioning, orientation of guidance gimbal support, and planetarium representation.

• **Magnetic field control.** This station will operate the magnetic loops for static control of amplitude and direction of magnetic fields, and dynamic aspects of their derivations.



New Tatnall Metal Film 102 higher-temperature backed strain gages from Bull

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Safety Valve FOR AN ASTRONAUT

If America's first man-carrying rocket runs into trouble, a unique Donner device will play a vital role in bringing the Astronaut safely back to earth.

Known as a "maximum altitude sensor," the all solid-state system is essentially a fixed purpose miniature analog computer housed in a magnesium case only five inches long. Installed in the capsule, it goes into action if it is necessary to abort the rocket flight before the Astronaut's escape tower is jettisoned.

What it Does

The Donner device, which was developed for McDonnell Aviation with the approval of NASA, provides programmed time delay that operates rescue devices at maximum altitude.

Under abort conditions, the maximum altitude sensor provides output information which will:

1. Energize devices for firing the explosive bolts holding the escape tower onto the top of the capsule. This allows the escape tower to separate.

2. Energize the system which causes the escape tower jettison rocket to fire. With the tower separated, barostats are armed to open parachutes and furnish the Astronaut's capsule a safe descent.

Specialists in Analog & Digital Dynamics

Donner's maximum altitude sensor is another product from a firm specializing in the manufacture of accurate fixed and general purpose analog and digital systems designed to analyze, measure, and control inputs interlocking time, acceleration, jerk, velocity, and other dynamic inputs.

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British Study Wing Jets for STOL Uses

By John Tunstall

London—New system of aerodynamic circulation control, for possible application in short takeoff and land aircraft, has been developed at the National Gas Turbine Establishment, Pyestock. The system is claimed to be an advance on the jet flap on which work first began eight years ago at Pyestock.

Based on model tests, using a 20% elliptical wing section, Dr. I. C. Cheeseman who heads the Pyestock team, told AVIATION WEEK he hoped soon to demonstrate lift coefficients as high as 7.5 and lift/drag ratios on the order of 25:1.

The flow pattern can be arranged to eliminate wing wake under cruise conditions.

The technique is based on the use of slotted air jets tangential to the wing profile around the leading and trailing edges, which promote a circular flow system round the wing. The effect is to displace the rear stagnation point, which theoretically at least could be moved to mid-chord giving maximum lift values.

Differential control of the slot flow provides a simple method of obtaining any desired aerodynamic characteristics according to a chosen flight regime.

Main Advantage

Main advantage of the system over the jet flap, Cheeseman thinks, is the lower slope of the lift incidence curve, which renders the lift system less sensitive to gusts.

Pyestock technicians see the application of the system as the answer to the short takeoff and land air transport. "The most logical approach to the landing and takeoff problem," Cheeseman said, "is to reduce distances as a first step, rather than abolish them." Takeoff and landing distances of typical jet transports could be halved with the Pyestock system, he added.

Results to date have been based on slotted cylinder models, and on small elliptical wings with a single upper and lower slot only, 0.005 in. wide. A more elaborate and necessarily larger series of models is now being prepared with a multi-slot system at the rear and forward nose section of the wing, on which it is hoped to achieve coefficients more nearly approaching the theoretical maximum values predicted. The models currently being used have already demonstrated on the wind tunnel rig lift coefficients of three and the reduction of wake drag to zero.

British Ramjet Trials

Results of ramjet trials concluded last year by the National Gas Turbine Research Establishment using 16 in. dia. engines in rocket-launched ballistic test vehicles reveal that the highest altitude attained with any vehicle was 106,000 ft.

In this same firing, the vehicle reached 70,000 ft. in 40 sec. before burnout, and attained a speed at that point of Mach 2.39. The highest speed attained in the test program was Mach 2.7. Typical speeds after coasting to ceiling altitude were about Mach 1.88.

Experience in this test program's is believed to have substantially improved the performance of the Bristol Bloodhound.

Other major work currently under way at the $42 million development facility at Pyestock is centered on the development of supersonic intake geometry.

Emphasis appeared centered on intakes providing wholly internal shock compression system for cruising regimes around Mach 2 and on mixed internal external compression intakes for higher cruise speeds. Installations incorporating novel variable geometry features apparently have been developed in both categories but no details were obtainable.

The usefulness of hinging engine pods to minimize effects of incidence on pod drag and intake geometry also is under investigation.

Engine test facilities at Pyestock will soon be implemented by two further test cells, the first of which is considered by the British designers to be the most flexible of any known large test facility. Costing $10 million, and now nearing completion, the Pyestock No. 3 cell will undertake subatmospheric testing up to 100,000 ft. with full engine exhaust expansion, and accept any transient engine or flight condition demanded. Cell has a diameter of 20 ft. and is 80 ft. long.

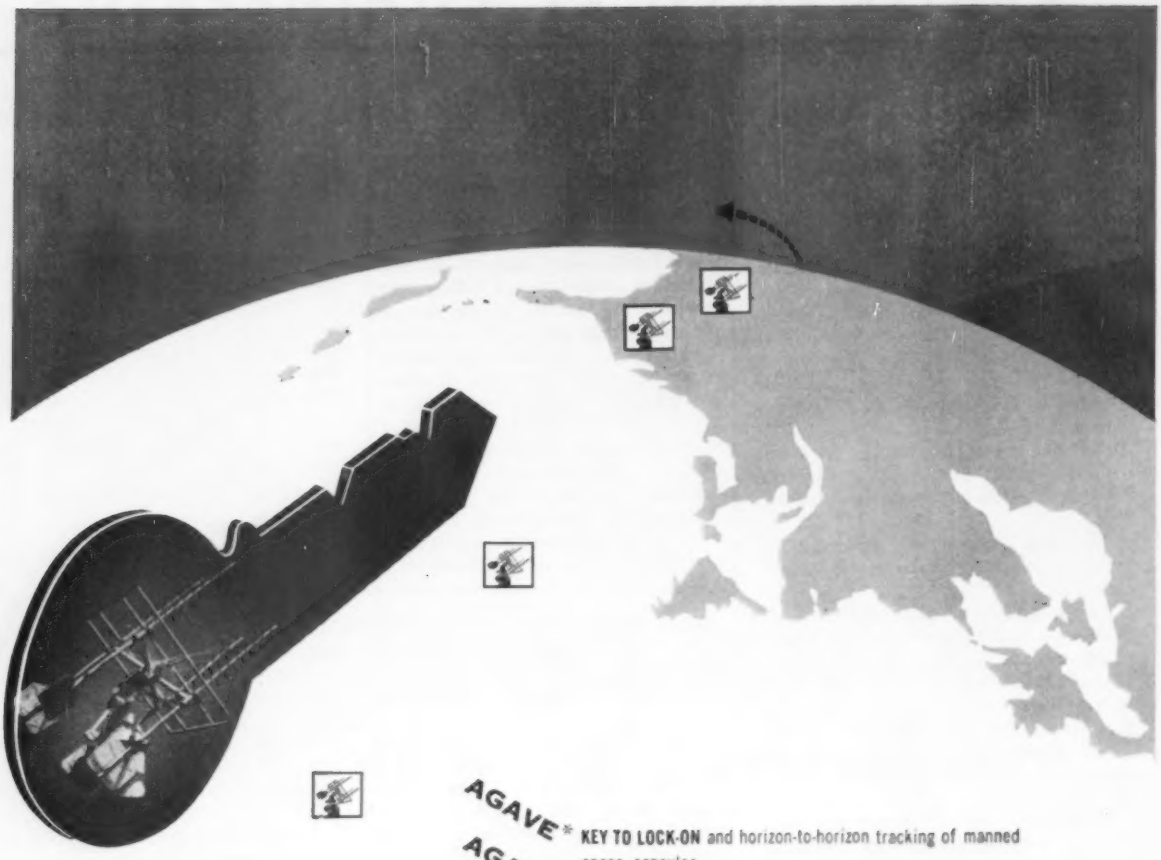
Rapid Response

It will accommodate ramjet or turbojet engines with up to 300 lb. sec. mass flows and can work with speeds up to Mach 2.8. Rapid response to intake temperature demands up to 600C during an engine or flight program is obtained by the use of a large oil-fired air heater which has a heating capacity of 65-million Btu./hr. Intake temperatures down to −70C are achieved by a 36,000 hp. air expansion/refrigeration system.

Pyestock technicians regard the compressor installation as the largest in the world for a single test cell. The compressor building houses eight compressor banks, each of which comprises three 12,000 hp. centrifugal compressors in series driven by a 36,000 hp. electric motor. Total horsepower installed

Saunders-Roe Wasp Makes First Flight

Saunders-Roe Wasp, powered by a de Havilland Gnome turbine engine, is shown on its first flight, piloted by K. M. Reed, chief test pilot. Gnome engine produces 1,000 shp. Stabilizer under tail rotor is similar to that on the P.531 Mk. 1 turbine helicopter.



AGAVE* **KEY TO LOCK-ON** and horizon-to-horizon tracking of manned space capsules

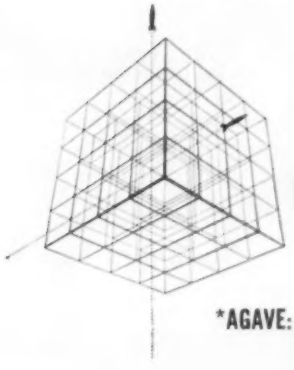
AGAVE **KEY TO NARROW-BEAM-RADAR ORIENTATION**; key to immediate acquisition of lower-level airborne signals and subsequent reacquisition if target is lost (direct transfer of gimbal angles)

AGAVE **KEY TO AUTOMATIC-TRACKING ANTENNAS** for extended range telemetry . . . a broadband front-end passes the entire telemetry band simultaneously . . . acquisition and tracking are independent of carrier modulation

AGAVE **KEY TO RANGE SAFETY** where angle-only information is sufficient (two AGAVEs provide complete position data)

AGAVE **KEY TO DRONE GUIDANCE** when augmented by Cubic DME (Distance-Measuring Equipment), a command generator, and a miniature airborne decoder

AGAVE **ONE OF MANY** challenging Space-Age projects at Cubic inviting employment inquiries from interested engineers



CUBIC CORPORATION

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***AGAVE:** Automatic Gimballed-Antenna Vectoring Equipment

amounts to 360,000 hp. Motors and compressors are supplied by General Electric Co., Ltd., and are similar to equipment supplied by the company to the steel industry.

Each compressor bank develops a pressure ratio of 9:1 and all the banks can be connected in series to give an over-all ratio of 72:1. A ring air main connects the powerhouse of this cell to other test facilities on the site.

Fully automatic data handling is a feature of the installation. All pressure, temperature, thrust, speed, fuel flow data, etc., is computed and then stored. Some data is computed synchronously and up to six computed channels may be played back and presented graphically as the engine test proceeds. The remaining data is computed later and presented in reduced form, either typewritten, plotted or punched.

Results of other Pyestock projects include a high vacuum method of joining turbine blades to the root; correlation of noise levels (decibels) with annoyance factors, and the establishment of a relationship between the disintegration pattern of turbine disks and strength and ductility characteristics.

The need to join a turbine blade to its root arises with air-cooled turbines. Pyestock engineers developed an installation in which the brazing metal was introduced to the parent metal joint interfaces under various temperature conditions and high vacuum. The joint was then closed under pressure. Joint tests showed tensile strengths equal to the parent metal and no evidence of the interface survived.

This led to a series of tests in which no brazing metal was used. These revealed, AVIATION WEEK learned, that the brazing metal made no contribution to the joint. The high pressure, high vacuum, hot joining process created sufficient conditions to ensure an intimate welding of the joint faces. The results of this latest work at Pyestock may lead to the adoption of the joining process without brazing metal.

Virtually all air-cooled turbine blades in service in British engines are extruded from round billets in which the air cooling holes have already been introduced as part of an earlier extruding operation. The billets are then forged or pressed into final shape and the holes deformed in this process to form the cooling matrix properly located with respect to the temperature gradients in the blade.

Only the nature of the hole distribution is believed to distinguish the two types of blades in service. The cheaper blade has only three relatively large holes against a multiplicity of very small holes, the latter providing the most efficient distribution, a factor of importance only in much higher rated military engines.

at ground level or at 50,000 feet...

Pacific's AUTOMATIC ESCAPE/RECOVERY COMPONENTS

improve flight personnel safety!

...PACIFIC LITERALLY HELPS TO BRING THEM BACK ALIVE!

Escaping from a high performance airplane is a treacherous business under any condition. At 50,000 feet or more the pilot must reach a much lower altitude swiftly; at low altitudes a very rapid and closely controlled sequence of events must take place to deploy the pilot's parachute before he hits the ground . . . and at supersonic speeds the pilot must decelerate to a safe speed before separating from his ejection seat.

Providing escape capabilities to meet all of these conditions, even when the pilot is partially incapacitated, means that *automatic escape and recovery is a must*. To meet this challenge, Pacific Scientific has developed a complete series of products capable of reliable performance within the rigorous time-phase requirements dictated by such emergencies . . . no matter what the speed or altitude.

Each Pacific product shown here represents a major investment in design and testing to insure a highly reliable power package controlled by a precision instrument mechanism. Combining technical know-how in instrumentation with heavy experience in aneroid, spring and ballistic-actuated mechanisms has resulted in these proven devices which make reliable, automatic escape and recovery a reality.

Pacific Scientific's extensive experience can provide the solution to your problems.

BALLISTIC INERTIA REEL
Pacific's proven and highly reliable inertia reel concept has been incorporated into a new device that has the added capability of retracting the straps. When pilot actuates the pre-ejection system, a propellant charge—remote or integral—firmly positions the pilot for maximum safety in ejection.

SPEED SENSOR
This device continuously monitors the speed of the plane. Depending upon the speed at ejection, it selects appropriate ballistic time-delays to permit automatic lap belt and shoulder harness release.

SEAT SEPARATOR
Releasing lap belt actuates the seat separator which tightens a strap between pilot and seat. This acts as a "sling-shot" forcibly separating pilot from seat.

PARACHUTE RELEASE
At instant pilot and seat separate, the arming cable of parachute release is automatically pulled. If this occurs above pre-selected altitudes, the aneroid element will prevent parachute deployment until pilot falls to this altitude. If seat separation occurs below pre-selected altitudes, parachute deployment is instantaneous.

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SMOKE SCREEN helps conceal a helicopter assault during Army's Exercise Elk Horn at Yakima Firing Center, Wash.

Helicopters Demonstrate Assault Tactics

By Russell Hawkes

Yakima, Wash.—Helicopter operations in Exercise Elk Horn of Strategic Army Corps' 4th Infantry Division here indicate that the helicopter has roles in land warfare which apparently cannot be filled by any of the new VTOL and STOL concepts.

Only 94 Army helicopters and airplanes could participate in the 18,000-man war games on arid, 280,000-acre Yakima Firing Center. The psychological and physical effects of helicopter-borne raids and vertical envelopments on an enemy were demonstrated repeatedly. Most of the Army aviators polled said the helicopter is better suited to such attacks in, or close to, the battle area than proposed tilt-wing, thrust-deflection or convertiplane designs. The roles they see for the new designs as troop and cargo carriers are in supply and troop movements over friendly territory and in very deep penetrations to lightly defended landing areas.

Proposed Designs

Existing large aircraft are not well tailored to Army needs, according to Maj. Gen. Louis W. Truman, commander of the 4th Division and deputy director of Exercise Elk Horn. Large versions of the proposed designs could offer high speed cruise over long ranges and the ability to operate at unprepared sites. Gen. Truman said specialized aircraft, primarily serving the Army, could prevent the type of delay the service suffered during the Lebanese crisis, when Army troops arrived late because of inadequate air transportation.

Within a battle area, the helicopter should prove more versatile and probably less vulnerable. To obtain information first-hand, an AVIATION WEEK editor went with a helicopter-borne "aggressor" force on a night assault behind "U. S." lines. The tactical usefulness of vertical envelopments and helicopter raids is due largely to psychological effects on the enemy and the necessity of spending time and substance on the defense of his rear areas.

Helicopter Assault

The aggressor helicopter assault produced these examples:

- **In the dark,** two defending units mistakenly engaged each other in a sharp fight before umpires separated them to prevent unnecessary risk of actual bloodshed. Simulation of combat sometimes becomes too perfect.
- **Helicopter assault force** found and theoretically destroyed road and airstrip building equipment of a combat engineer unit called away to defend another place against helicopter-borne raiders who never came there.
- **Roadblock was set up** and for 15 min. delayed the movement of reserves to oppose an attack coming overland.
- **Two days later,** a commander of the defending forces said early reports had indicated that the assault force could number 300 men. To allow for multiple sightings and the natural exaggeration of men under stress, he discounted that by one-third and was reasonably confident that about 200 men were involved. Actually, there were only 90.

The number of heliborne attackers captured or estimated killed in action was 19, much fewer than could be expected in actual combat, but experienced officers said the results would have justified heavy losses. In the opinion of umpires and military observers, the defenders reacted well and the uncertainty and confusion produced were the least that could have been expected.

The ability of the assault force to deceive the defenders about its exact location until the shooting started was due largely to the special virtues of the helicopter and was probably enhanced by their distinctive noise and the peacetime necessity of carrying lights. The approach flight and departure from the troop landing areas were made through circuitous canyons and dry river beds, usually below the edges or banks.

The Vertol H-21 troop carriers flew in a strung-out line-astern formation. Each was airborne again within seconds of disembarking its assault troops and a steady stream of empty helicopters looped back across the approach route, faking landings and looking to defenders like a new attack. Two Sikorsky H-19 helicopters were used to make simultaneous diversions by landing at various places, firing machine guns, and disappearing. The command post of the defending 4th Division received a steady flow of landing reports from units throughout its area. At least one was completely imaginary. Not even a diversion was made there.

Nearby defending units responded quickly and aggressively by sending mechanized patrols into some of the reported landing areas, including the real one and the completely imaginary one.

Little was accomplished by the patrols because of the difficulty of finding the hidden and dispersed aggressors in the dark.

Confronted by a strong attack on the

Aloha Airlines' F-27 turboprops use AeroShell Turbine Fuel, supplied by Lockheed Air Terminal, Inc., Shell's distributor at Honolulu International Airport.

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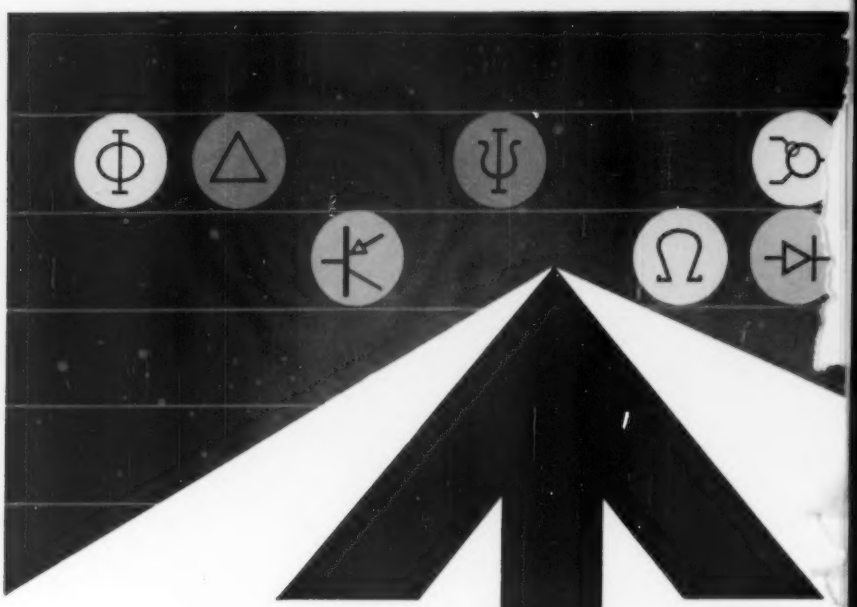
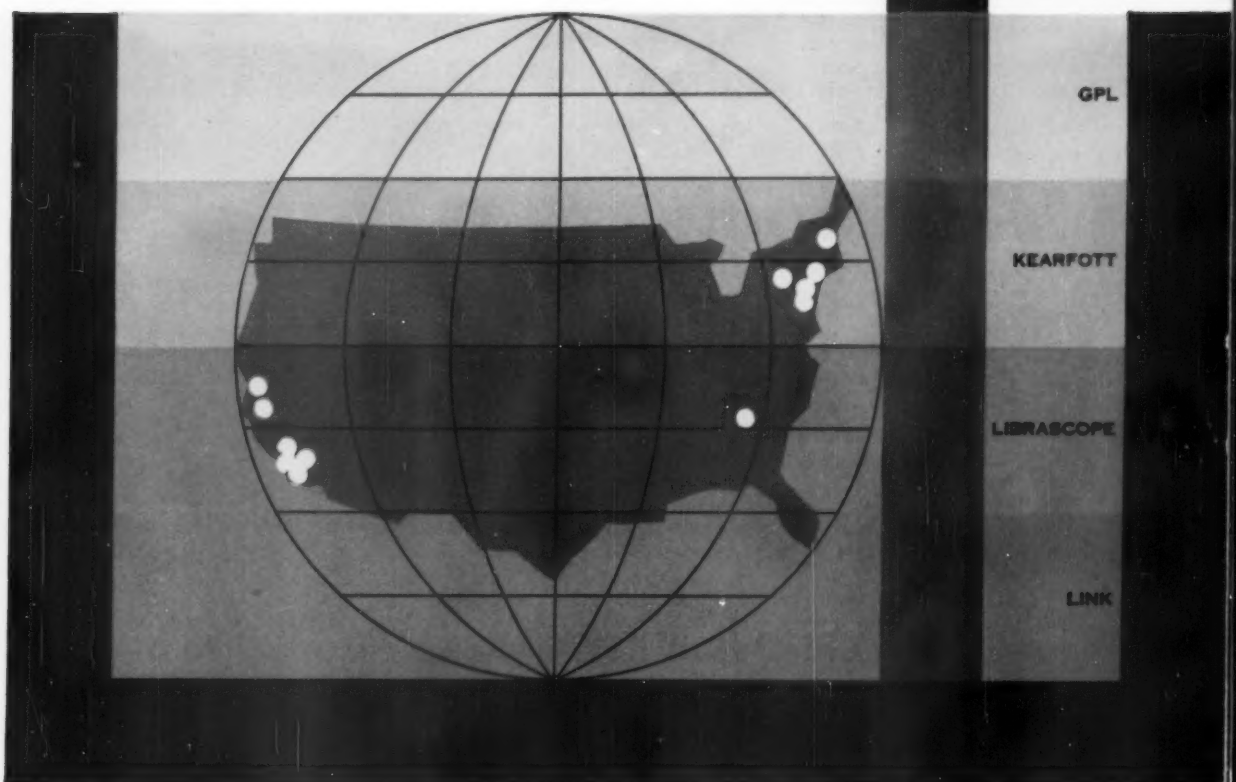
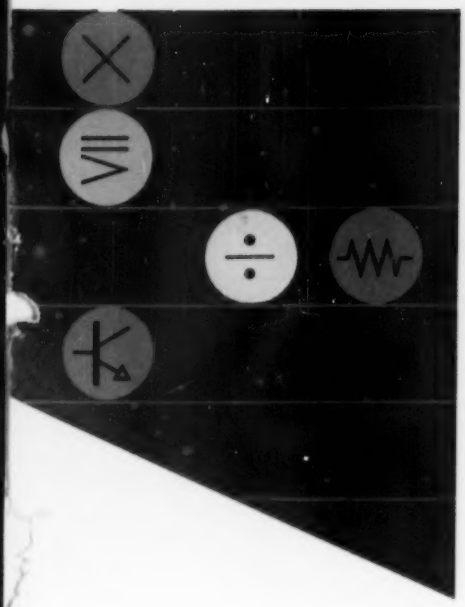


GENERAL PRECISION...ELECTRONICS TO THE FOURTH POWER





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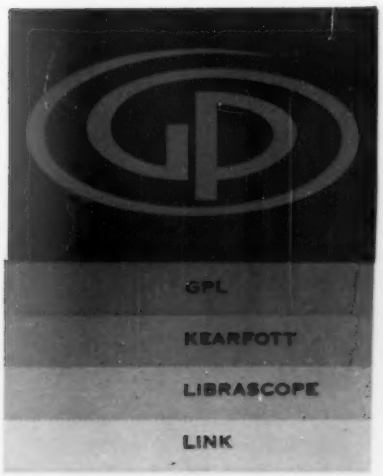

GENERAL PRECISION, INC.

One of a series depicting historic incidents in military communications

DATA LINK AT CHAERONEA —338 BC

Polyblus the historian tells of a data link system employed at the time Alexander the Great and his Macedonian cavalry crushed the Greek forces of Demosthenes and reduced Greece to a dependent status for the remainder of classical antiquity. It consisted of a series of signal walls on which torches were displayed in combinations representing letters of the Greek alphabet. Although slow, the system proved superior to the use of couriers.

Today, instantaneous and completely reliable Electronic Communications make possible the immediate and continuing interchange of information and orders any place in the world. ECI is proud of its responsibilities in the design, development and manufacture of this advanced equipment required in aerospace and surface roles critical to our National Defense. ECI communications and data link equipments form an integral and most essential part in the new and vital ALRI (Airborne Long Range Input) program linking USAF's advanced early warning system to SAGE—our continental defense network.

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ground, Brig. Gen. William O. Blandford, commanding the division during the maneuvers, decided he could not spare forces to find and destroy the assault before daylight. The unsuccessful patrols were pulled in and rear area installations were buttoned up within defensive perimeters.

The roles played by helicopters in the assault could have been played by fixed-wing VTOL aircraft only with difficulty, the helicopter pilots say. Designed to cruise in the configuration of a conventional fixed wing airplane, they have extremely heavy disk loadings and correspondingly high power requirements when the engines are used to produce vertical lift at very low speeds or while hovering. Their high cruise speeds cannot be used in night approach flights through winding gullies and the use of terrain for concealment and protection against enemy fire is a key part of Army air tactics. With vertical thrust at low speeds, high fuel consumption would cut into payload or range. Also, the heavy disk loading should make it difficult to design them with the necessary maneuverability.

Ingestion Problem

In the powdery volcanic dust found on the Yakima Firing Center and in many potential combat theaters the high downwash velocities that go with heavy disk loadings would multiply maintenance problems caused by ingestion of foreign objects and abrasion of moving parts.

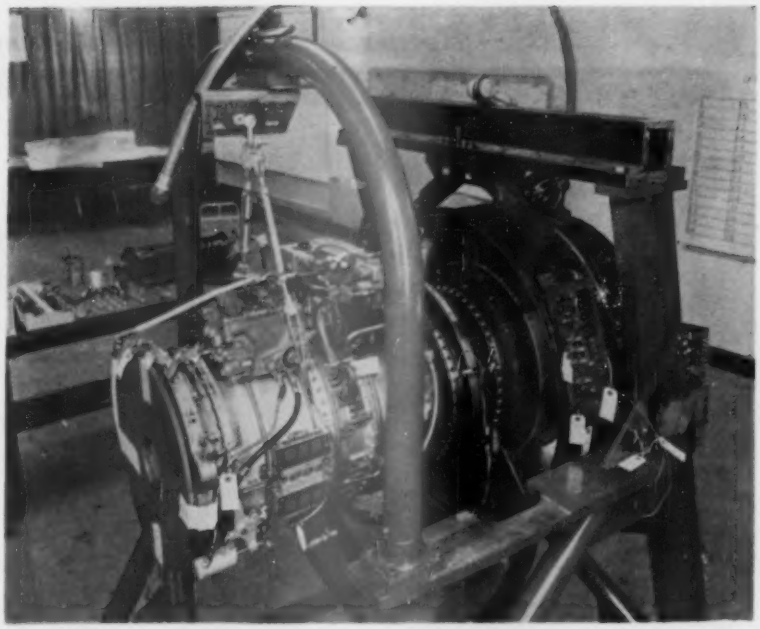
Simulation of combat was not perfect in the helicopter operations, because some peacetime safety measures were taken. Anti-collision lights and the characteristic fluttering sound of rotors are useful tools to confuse and distract a make-believe enemy, but certainly not a real one.

An automatic weapon or missile battery with a clear field of fire can easily shoot down a helicopter.

The strung-out formation used in Exercise Elk Horn creates an impression of large numbers, but might not be a good idea in actual combat because of the time it gives an enemy to bring weapons to bear on the approach route and shoot down the last helicopters in the string.

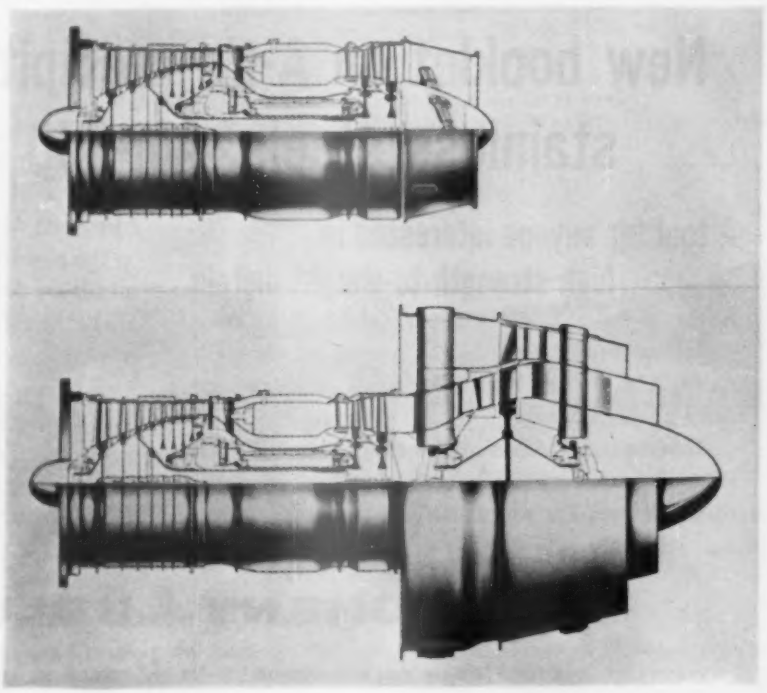
While Army pilots are expert at capitalizing on rugged terrain for protection against enemy fire, some wars are fought in the flatlands. Even in mountains there is a high probability of flying over a defensive position right under the approach route. There are tactics for dealing with these situations. Smoke and chaff can be used for concealment and firepower can be used to make the enemy keep his head down.

Missile and gun carrying helicopters being developed by Army should prove to be the best tools for suppressing



GE Tests CF700; Announces CJ610 Light Turbojet

First photo of General Electric's aft turbofan CF700 shows the instrumented 4,000-lb.-thrust engine mounted in a thrust frame for its first series of test runs at the company's Small Aircraft Engine Department, Lynn, Mass. The engine, a derivative of the J85, is being considered as the powerplant for the McDonnell 220 business jet transport (AW Mar. 7, p. 334), but McDonnell has not yet decided whether to go ahead with this project. CF700s for flight test are scheduled to be produced by April, 1961, and FAA certification is expected by February, 1962. Civil turbojet version of the J85, the CJ610, is being offered by GE as a powerplant for jet executive aircraft. Certification is expected to be obtained by December, 1961, and production copies are scheduled to be available by February, 1962. Drawing shows CJ610 at top and CF700-2 at bottom. The 355-lb. CJ610 will have a guaranteed maximum continuous thrust of 2,700 lb. and a thrust-to-weight ratio of 7.6. Specific fuel consumption at sea level will be .95. The engine, basically a CF700-2 without aft turbofan components, will sell for $57,000.



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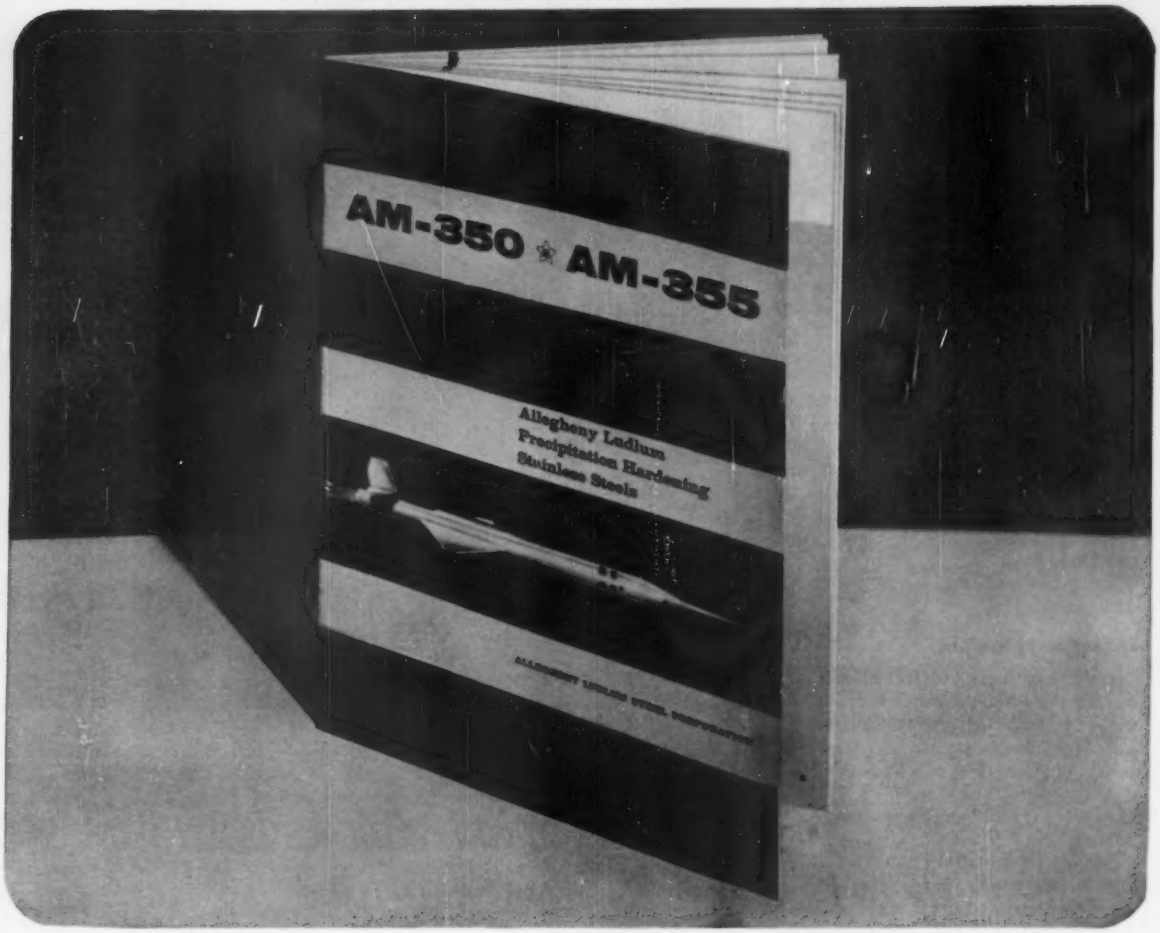

New booklet on A-L's precipitation-hardening stainless steels, AM-350 and AM-355

A tool for anyone interested in high strength-to-weight metals

In this technical booklet, you get the facts on Allegheny Ludlum's precipitation hardening stainless steels, AM-350 and AM-355, metals developed for space age requirements.

AM-350 and AM-355 combine these unusual qualities. They are easy to fabricate. Have high strength-to-weight ratios at room and elevated temperatures combined with excellent resistance to corrosion.

The physical and mechanical properties of the two metals are described in 33 charts and tables. Included are heat-treatment and fabrication data, eight photomicrographs and a section on corrosion resistance with representative values in selected environments.

It's jam-packed with data. For your free copy, see your A-L representative or write *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept. AW-6.*

***

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enemy fire from positions close to the approach route because of their ability to stay with the troop carriers.

Support by artillery or fighter-bombers of USAF Tactical Air Command calls for close coordination. The troop-carrying helicopters follow a strict flight plan to stay close behind a no-fire line which advances along the approach route according to an equally strict schedule and is obeyed by artillery commanders and forward air controllers. Local air superiority is virtually a necessity for vertical envelopment operations.

Army aviation officers flying in the maneuvers said the service would use fixed wing VTOL airplanes differently than helicopters. They explain that the variety of services which aircraft can perform for an army is so great that many specialized designs are needed. The fixed wing VTOL and STOL designs offer the speed and range which the helicopter lacks. Used as an assault troop carrier, such an airplane would be capable of much deeper penetrations that would produce a correspondingly more widespread effect in combat.

Shallow envelopments and raids close to the battle area can produce more intense effects on the enemy within a smaller radius. A mix of weapon and troop carrying helicopters seems best for these to most of the Army aviators who were asked.

Price of Versatility

Army aviation must pay a price for the versatility it needs. To support a variety of aircraft, the service must sometimes make do with fewer of a given type than it ought to have. Tight funding contributes to the problem. A pentomic division has assigned to it a single aviation company to provide liaison transportation, lay telephone wire, spot artillery fire, evacuate casualties, conduct radiological surveys, operate airborne communications relays, visually control troop movements on the ground, etc. An officer of the 4th Aviation Company, which serves the 4th Infantry Division, estimates that a pentomic division in combat really needs two or three times the organic aviation it has.

To get maximum utility from its aircraft, the Army keeps specialized units with a single type of aircraft at the corps level or higher. These can be ordered where they are needed most.

The aggressor assault in Elk Horn was flown by the 57th Transportation Company (helicopter), attached to the 4th Division especially for the maneuvers. With 80% of its Vertol H-21 helicopters available, such a company is capable of supplying one of the five battle groups in a pentomic division continuously with everything except fuel for the battle group's vehicles, if the battle group is no more than 50 mi. from the source of supply. A mechanized column must still depend on its "land tail" for fuel. The 80% availability level enables the transportation company to airlift an infantry company up to 50 mi., evacuate 192 wounded in one lift or carry 31.5 tons of equipment.

Given normal supply of spare parts and reasonable luck, a helicopter transportation company can hope to maintain 80% availability for three weeks in the field. Field maintenance echelons cannot cope with serious repairs to some key assemblies such as transmissions, rotor hubs, etc., and not much sheet metal work can be done forward of the Army corps level.

It seemed to most military observers

Army Caribou Operates From Dirt Strip

Aft view shows Army's AC-1DH Caribou on dirt strip. The cargo aircraft, built by de Havilland of Canada, can carry 24 fully-equipped cargo troops or 6,000-lb. of cargo. Range is 200 mi. maximum; operating speed range is 70-182 mph.

First Photo Shows Gloster Javelin's In-flight Refueling Boom

Gloster Javelin equipped with in-flight refueling probe is shown for first time. Note vortex generators slightly aft of leading edge on outer portion of wing. Gloster is conducting a major modification program of Mk. VII Javelins (AW May 23, p. 94).

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New Departure is also supplying high-precision rotor bearings for the inertial guidance system in Polaris.

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questioned that a light helicopter transportation company like the 57th should be organic to the division. The present table of organization call for only 12 to a field army. Altogether, they would be able to carry 3,024 men or 318 tons of equipment in a single lift.

Army field operations cause equipment to run down faster than it would in operations from a permanent base. A Vertol H-21 requires about 10 man-hours of maintenance for every hour of flight and even simple jobs can become complicated under the primitive conditions of combat. Fatigue of maintenance crews can cause a loss in capability. Dust, mud, rain and variable temperatures impose stresses on men and equipment that are not met in a more settled existence.

In Exercise Elk Horn, about half the helicopter maintenance problems were caused by powdery volcanic dust getting into bearings. Another problem was caused by wooden rotors with metal leading edges. In the arid climate of the Yakima Firing Center, the wood blades shrank and separated from the leading edges. The supply of spare blades in the field was inadequate and the 57th Transportation Company had to cannibalize some of its helicopters temporarily to make others flyable. Army aviators report that it is sometimes difficult to get 55% availability after prolonged field operations and it has been known to drop as low as 40%.

Improved helicopter design can do much to improve availability and ease maintenance in the field. Lockheed Aircraft Corp. sent a team of experts to Exercise Elk Horn to study the problem at first hand. Lockheed is working on a helicopter and two fixed-wing VTOL aircraft which it hopes to sell to Army.

Every improvement in mechanical transportation has been a mixed blessing to the Army. While faster vehicles improve mobility, the heavy logistic support they need can reduce mobility. The complicated supply arrangements behind a modern mechanized column mean that a logistic deficiency can pin it down as effectively as enemy fire.

The same thing is true of Army aviation and the variety of equipment it operates adds one more layer of complexity to logistics. During Exercise Elk Horn the 4th Aviation Company had to be supplied with three types of aviation fuel, including JP-4 for its Bell HU-1A Iroquois turbine-powered helicopter. The eight different types of piston-engine helicopters and airplanes used aviation gasoline with two different octane ratings. Because of this, fuel reserves had to be much higher than if a single fuel were used. The same problem exists with spare parts because so few are standardized.

What the weight of these extra reserves means to the mobility of an Army unit in the field can be seen by noting that extra trucks or aircraft are needed to carry them and these, in turn, need their own fuel and more spare parts.

Navy Hydrofoil Decision Due

Washington—Final decision in Navy Bureau of Ships' competition for a 110-ton hydrofoil anti-submarine patrol craft with top speeds of at least 45 kt. is expected within the next few weeks.

Bidders on the contract—including a number of aviation firms—represent the largest number of companies to bid in a Navy ship competition in recent years. Primary reason for the wide interest is the belief that hydrofoil systems have a great potential in all types of seagoing craft.

Designated the PC(H), the vessel will have a relatively-flat, heavier hull shape than the V-shaped "seaplane"-type hull planned for an 80-ton, 60-kt. hydrofoil under development for the U.S. Maritime Administration by Dynamics Developments, Inc., a Grumman Aircraft Engineering Co. affiliate (AW Feb. 22, p. 80).

Bureau of Ships spokesmen say the heavier hull is needed to give the vessel the capability of remaining in the water and off its foils for extended intervals in all types of seas.

While making high-speed runs on its foils, the Navy vessel will be powered by two Bristol Siddeley Proteus engines derated to extend the periods between major overhauls. A high-speed diesel engine, giving the hydrofoil a speed of up to 12 kt., will be used when the vessel is running on its hull.

Under present planning, the ship will spend most of its time on its hull to give it longer duration at sea.

Operationally, two PC(H)s will work together in what the Navy describes as a "grasshopper" technique. One, resting on its hull, will move slowly through the water listening for submarines with long-range and variable depth sonars. When the slow-moving listening vessel detects a submarine, it will signal its partner to move at top-speed ahead of the submarine to assume a new listening post. Eventually, one of the two theoretically will be near enough to a fast-ranging nuclear submarine to make the kill with homing torpedoes.

Rear Adm. R. K. James, Bureau of Ships commander, told a House Science and Astronautics Subcommittee recently that the need to test the grasshopper" concept is one of the primary

a new concept for ordnance safety in missiles and space vehicles . . .

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KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Normalizing Alloy Steels

There are several forms of heat-treatment commonly employed in the processing of alloy steels. Each in its own way modifies the mechanical properties and structures of steel, and each is chosen with a definite objective in mind. The five usual forms of treatment are normalizing, annealing, spheroidize-annealing, quenching and tempering, and stress-relieving.

In this particular discussion, let us consider briefly the purposes and effects of normalizing.

Normalizing is an operation in which the steel is heated to approximately 100 deg F above the upper transformation range, then cooled in still or agitated air. The basic purpose is to refine the prior structure produced by variations in finishing temperatures encountered in rolling or forging. The structure resulting from normalizing, being more uniform, will help create improved mechanical properties when the steel is subsequently reheated, liquid-quenched, and tempered.

There are times when large steel parts (heavy forgings, for example) cannot be liquid-quenched because of their size. In cases of this nature, the heat-treatment must consist of single or multiple normalizing followed by tempering.

High-temperature normalizing is sometimes used for grain-coarsening low-carbon alloy steels to promote machinability. (In high-temperature normalizing, steel is heated to more than 100 deg F above the upper transformation range.) At times it is possible to machine a steel in the air-cooled condition, the governing factor being the alloy content. However, the highly alloyed analyses may require annealing or tempering after normalizing, to decrease the hardness.

It is essential, when normalizing is employed, that free circulation of still or agitated air be provided. When air-cooling of individual bars or forgings is not practicable, the furnace charge should provide for some means of separation, such as racks or spacers.

If you would care to know more about normalizing, or any other phase of heat-treating, you are invited to consult with Bethlehem metallurgists. They are always glad to give you any help you need.

And remember that Bethlehem makes the full range of AISI standard alloy steels, as well as special-analysis steels and all carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

reasons for the present competition "since we have no analogous ships with which to try it out."

Adm. James said aviation firms with waterfront facilities were invited to compete directly, those without such facilities to enter on a team basis with shipbuilders.

"I am sure," he said, "that we shipbuilders, both naval and commercial, can learn a great deal more from aircraft manufacturers, especially about lightweight frames, engines, structural members." He added that the Bureau of Ships also is encouraging private shipbuilders "to get an injection of aircraft-type experience and use it."

He told the subcommittee that "a great deal of work" remains to be done before Navy can go to hydrofoil vessels of 200 tons or more, "and we expect to get some assistance, directly or indirectly, from the aircraft industry."

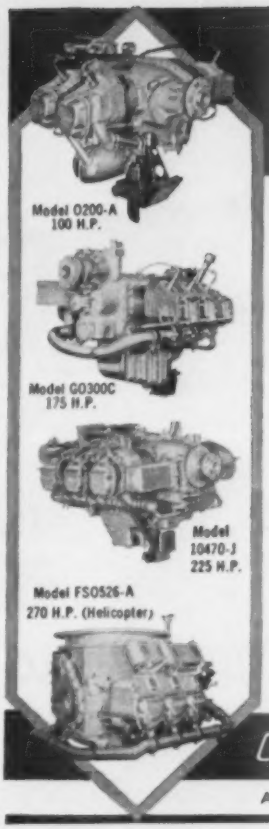
Problems to be overcome, Adm. James said, include means of cutting down hull and machinery weights, strengthening foil structural members and increasing propulsion efficiency, as well as "a lot more information on supercavitating foils."

PRODUCTION BRIEFING

British Aircraft Corp., group formed by merger of English Electric, Vickers-Armstrongs and Bristol Aircraft, has reached agreement for acquisition of controlling interest in Hunting Aircraft, Ltd. British Aircraft Corp. will be headed by Lord Portal of Hungerford, former chairman of British Aluminium, Ltd. Corporation is capitalized at $56 million: $22.4 million each provided by English Electric and Vickers, and $11.2 million by Bristol.

Ansett Airways of Australia has ordered six Max Holste Super Broussard turboprop transports as replacements for its Douglas DC-3s. Super Broussard is powered by two Turbomeca Bastan turbines delivering 1,000 hp. each. First Super Broussard is scheduled to fly by the end of June; orders so far total 78.

Slick Airways announced recently that it has signed a definitive purchase agreement with Canadair, Ltd., for the purchase of two CL-44D turboprop all-cargo aircraft, with options on four more. The contract for over $9 million calls for delivery of the first swing-tail aircraft in September, 1961, the second in October, 1961. The remaining four optioned CL-44Ds are scheduled for delivery in 1962. Slick made a down payment of $900,000 at the signing of the contract. Slick officials said the CL-44D's operating rate of approximately four cents per ton mile will enable Slick to lower cargo rates.



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O200-A	100	2750	4	190	80/87
O300-A B & C	145	2700	6	277	80/87
GO300-C	175	3200	6	312	80/87
E225	225	2650	6	363	80/87
O470-K & L	230	2600	6	404	80/87
O470-M	240	2600	6	409	91/96
O470-G	240	2600	6	432	91/96
O470-H*	240	2600	6	472	91/96
IO470-C	250	2600	6	432	91/96
IO470-D	260	2625	6	426	100/115
IO470-F	260	2625	6	426	100/130
IO470-J	225	2600	6	402	80/87
IO470-K	225	2600	6	391	100/130
FSO526-A**	270	3200	6	575	91/96
GSO526-A	340	3100	6	549	91/96

*Pusher Type engine with extended propeller shaft
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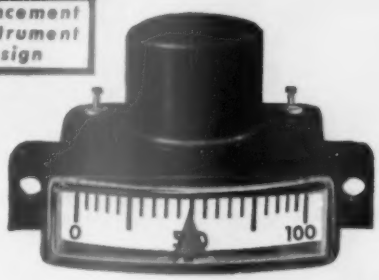


EDGEWISE METER

Large, easily read display (1 7/16" scale) in only 9/16" x 1 7/8" panel space. For horizontal or vertical mounting. Miniature, self-shielded Coaxial mechanism has stability and durability of larger instruments. Weight 1.7 oz. Supplied with combination mounting bracket and bezel (not shown). Data on request. Marion Instrument Division, Minneapolis-Honeywell Regulator Co., Manchester, New Hampshire, U.S.A. In Canada, Honeywell Controls Limited, Toronto 17, Ontario.

Honeywell
First in Control
SINCE 1885

75 YEARS PIONEERING THE FUTURE

Douglas RB-66 of USAF's 10th Tactical Reconnaissance Wing stands on ramp during filling of its liquid oxygen system (left), part of servicing routine done during daylight hours of Royal Flush Five exercise. Planes also were flown on long range night missions.

Tactical Teams Compete in Photo-Recon Event

English Electric Canberra PR-7 takes on a daylight photo mission. Canberra teams of Second ATAF swept the daylight event but lost night missions to the RB-66s.

Photo reconnaissance teams of the Fourth Allied Tactical Air Force nosed out units of the Second ATAF to win Royal Flush Five, the annual NATO aerial reconnaissance exercise staged at Bremgarten, Germany (AW May 30, p. 36). Fourth ATAF teams were from French and U.S. units; Second fielded teams from Belgian, British and Dutch squadrons. Canadians and West Germans were observers at the exercise; both nations currently have only strike units in NATO's posture although West Germans plan on reconnaissance capability by next year. Point scoring was based on the combined performance of pilots, airplanes, cameras and ground technicians. "Hot" reports were made by photo interpreters working with wet negatives. Reports included basic information, size and type of target, its capability, defenses and other data useful in planning an immediate strike.

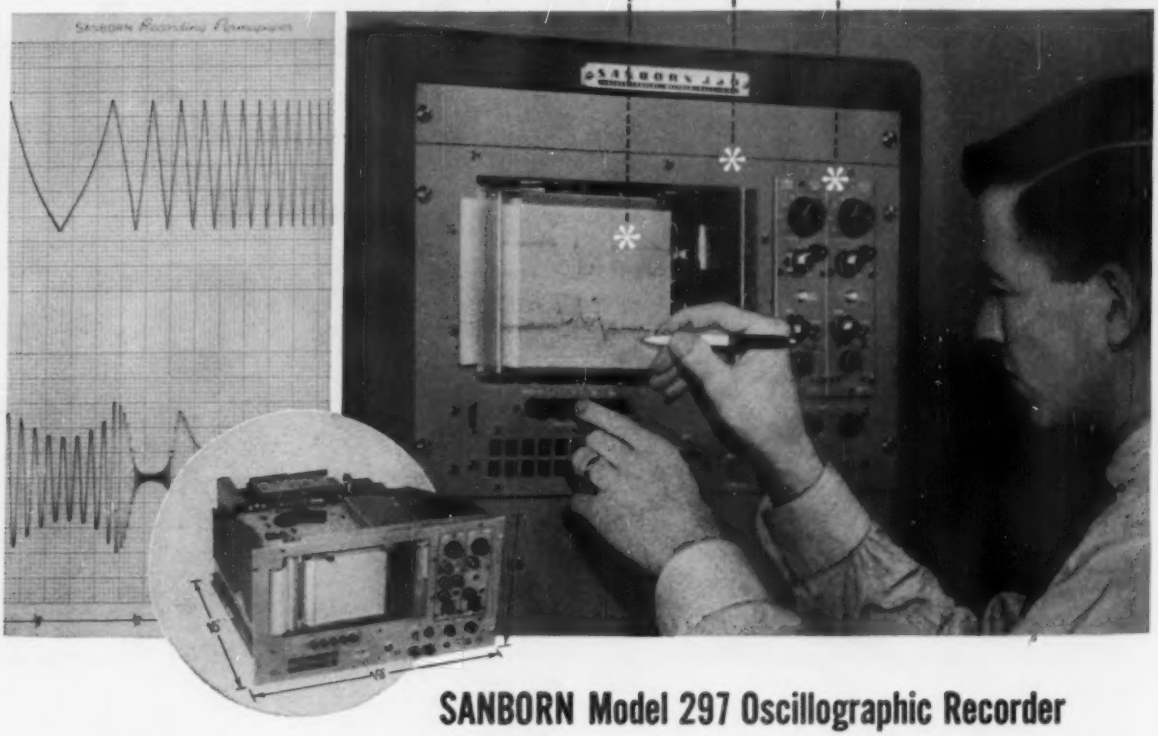
French air force Republic RF-84F takes off from Base Aerienne 136 near Bremgarten (left). French teams won the short range events and racked up largest team scores during the event. At right a Netherlands air force RF-84F taxis out to start a photo recon during Royal Flush Five. Dutch team beat USAF's McDonnell Voodoos in medium range missions.

One of five McDonnell RF-101C photo-recon planes of 66th Tactical Reconnaissance Wing taxis to revetment after a mission.

Vickers-Supermarine Swift FR-5 of Royal Air Force's No. 79 Squadron, is readied for a short range mission during Royal Flush Five. Below, RAF technicians swarm around a Swift, unloading magazines from the plane's nose and left-oblique cameras.

THIS NEW 2-CHANNEL DIRECT WRITER...

* *has easily read 50 mm wide, rectangular coordinate channels*
* *mounts in 10½" of rack space or in a separate portable case*
* *interchangeable "850" Series plug-in preamplifiers for each channel*



SANBORN Model 297 Oscillographic Recorder

Compactness and versatility without loss in performance is the design concept for this new 2-Channel Direct-Writer from Sanborn. The Model 297 provides two *complete* recording channels in only 10½" of panel space, making it extremely useful as a monitoring recorder — integrated with large instrumentation setups in data processing installations, test stands and similar applications. In its own portable case, the Model 297 will be equally useful in *laboratories and field applications* as a bench-top instrument.

Preamplifiers are "850" Series plug-in interchangeable units, available in Carrier, DC Coupling, Phase Sensitive Demodulator, and Low Level types. They may be used in any combination, one for each channel. An internal MOPA for carrier and chopper excitation is also available.

The basic recorder assembly houses a preamplifier power supply, transistorized power-amplifier power supply, and two transistorized current-feedback power amplifiers with *built-in electrical limiters* that provide damping at all times. The entire unit has built-in forced filtered air cooling.

The recording mechanism has rugged, enclosed galvanometers with velocity feedback damping . . . 4 different chart speeds selected by push buttons . . . timer/marker stylus with 1 second timer . . . approximately 6 inches of visible chart with immediately visible traces made by heated stylus. The electrical and mechanical specifications in combination with the many "big system" operating features make the compact Model 297 one of the most useful, reliable 2-channel direct writers available.

Contact the Sanborn Sales-Engineering representative nearest you or write the main office in Waltham for complete information and application assistance. Sales-Engineering representatives are located in principal cities throughout the United States, Canada and foreign countries.

Model 297 2-Channel Recording System Specifications
(Less plug-in preamps)

Sensitivity: 0.1 volt/mm nominal
Frequency Response: DC to 125 cps within 3 db, 10 mm peak-to-peak amplitude
Gain Stability: Better than ½% from 20°C to 40°C or line voltage change from 103 to 127 volts
Linearity: Max. non-linearity is 0.2 mm
Electrical Limiting: Approximately ±115% of full scale
Chart Speeds: 1, 5, 20, and 100 mm/sec. by mechanical push button
Dimensions: 10½" high x 16" deep x 19" wide
Paper Take-up: electrically operated

(Specifications are subject to change without notice.)

SANBORN COMPANY
Industrial Division
175 Wyman Street Waltham 54, Massachusetts

Ceramic Gyroscope Uses Gas Bearings

By Philip J. Klass

Minneapolis, Minn.—New miniature integrating gyro that uses a spinning rotor made of ceramic supported in gas bearings, which cuts gyro drift rate by a factor of 10:1, has been developed here by Minneapolis-Honeywell's Aeronautical Division. Improved accuracy is based on measurements made on a limited number of prototype units.

Specific drift rates are not reported by Honeywell. However, a 10:1 reduction in drift rate would put the gyro drift in the order of 0.0005 to 0.001 deg./hr. Vibration, or bearing noise, has been slashed by a factor of 30:1, Honeywell says.

New Honeywell gyro measures 2.8 in. in diameter by 2.75 in. long and weighs slightly less than 0.7 lb. Device has an angular momentum of 120,000 gram-centimeters squared per second. Engineering samples will be available late this year with full production starting early next year, company says.

Honeywell is the first to disclose a ceramic rotor gyro, but the use of air bearings to support the spinning rotor is a technique that has been employed previously by North American's Autonetics Division.

Although ball bearing quality and uniformity has improved greatly in recent years, the demands placed upon gyros have grown more difficult. One reason is the improved accuracy needed for long-range ballistic missiles. Another is the requirement for long life in storage, for missiles such as the Minuteman, where the gyro will be subjected to frequent operational checks over a period of several years.

The gas bearing offers a nearly frictionless support and without the spurious torques that can result from a slight shift of balls or retainers in conventional bearings. With the gas bearing, the spinning rotor is supported on a thin film of gas, such as helium or air, which measures only 25 millionths of an inch thick, in the case of the Honeywell gyro.

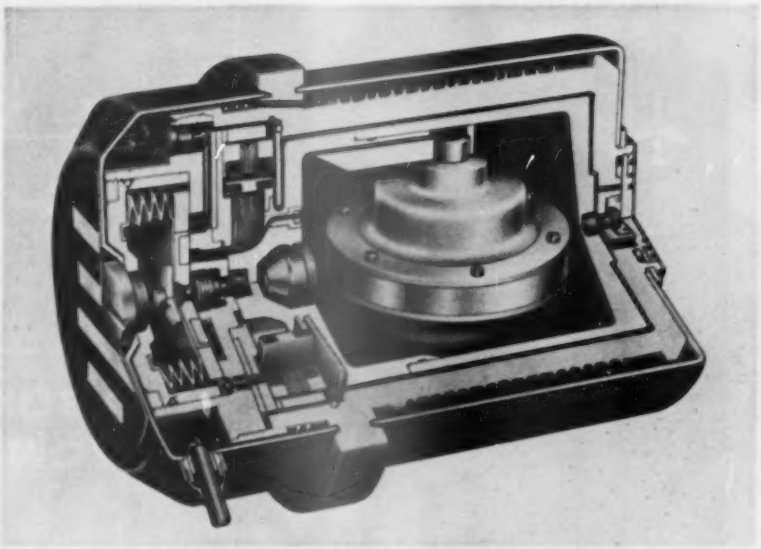
Because a clearance of only 25 millionths of an inch between two parts normally requires a press fit to mate them, if the gyro rotor is to be able to spin freely at a speed of 12,000 rpm., there must be a near-mirror finish between the surfaces and the material from which the rotor and its supports are made must have extremely high dimensional stability. Further the material must be extremely hard so that there will be no significant wear during starting and stopping operations when there is no cushion of gas to support the rotating mass.

The ceramic used in Honeywell's new gyro, once it has been cast and fired at a temperature of 3,200F, is as hard as sapphire and second on the hardness scale only to diamond, company reports. Models of the ceramic gyro have been started and stopped more than 6,000 times without significant wear, a spokesman says.

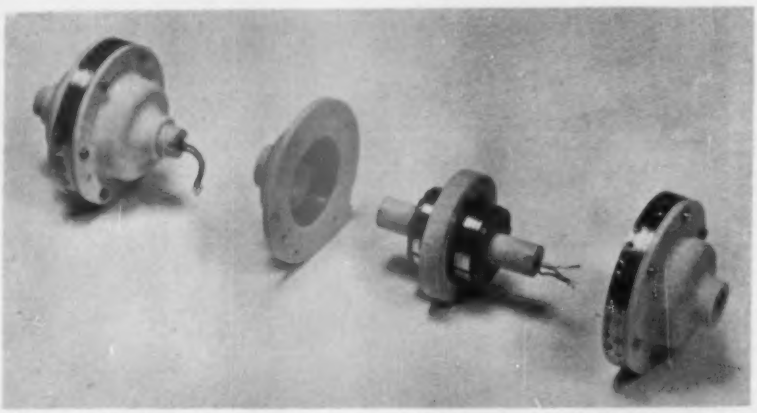
In addition, the ceramic rotor exhibits very high dimensional stability. Over a temperature range of −85F to 1,500F, it retains its machined dimensions to within two millionths of an inch.

Another feature of the ceramic construction is that hydrochloric acid can be used to completely cleanse the assembly of sub-microscopic particles that would adversely affect gyro performance.

The new gyro rotor consists of two ceramic hubs that are bolted to a tungsten alloy ring which provides the



CERAMIC GYRO, which uses gas bearings instead of ball bearings for spinning mass, reportedly has only 1/10th the drift rate of conventional miniature integrating gyro. New ceramic gas-bearing gyro, developed by Honeywell, weighs only 0.68 lb.



CERAMIC ROTOR ASSEMBLY, shown disassembled above, encloses stationary excitation windings. Metal liner inside ceramic rotor provides rotational torque while external metal band provides required rotor mass. New design cuts bearing noise by 30:1, Honeywell says.

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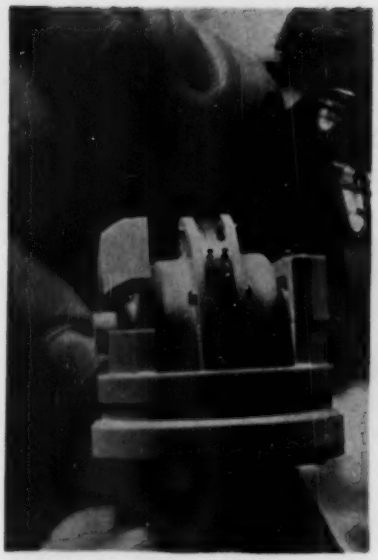

SMALL SIZE of Honeywell's new ceramic gas-bearing gyro rotor is shown above.

required mass for gyroscopic action. The rotor spins about a stator containing two field windings. Inside each of the ceramic hubs is a laminated hysteresis ring which develops torques that cause the rotor to spin.

The ceramic rotor is supported inside the ceramic gimbal with a clearance of about 100 millionths of an inch and the gimbal is filled with helium, nitrogen or other gas and sealed. (Present models are at a pressure of one atmosphere, but Honeywell is experimenting with higher pressure fills.) The entire gimbal assembly is floated in a liquid and restrained by jeweled pivots, with pick-offs and torque coils, much like a conventional integrating gyro.

When the gyro is started by applying an a.c. voltage to the stator (field) winding, the rotor, which has been in physical contact with the gimbal and the stator shaft because there is no cushion of air, begins to rotate. Small grooves inside the rotor hubs act like vanes to generate a flow of air between the spinning rotor and the stator shafts and the gimbal.

To give a feeling for the closeness of the fit between the rotor and the stator shaft, if a workman were to handle the shaft before the rotor were placed on it, the thickness of the film added by the workman's fingerprint would be enough to prevent the rotor from turning when voltage was applied, according to Mathew Riesgraff, project engineer in Honeywell's advanced floated gyro group.

Beyond the hardness and dimensional stability which a ceramic rotor

Atlas Airborne Command Guidance System

First photo of airborne portion of Atlas radio-command guidance system, used for recent 9,000 mi. flight and for 22 out of 24 successful Atlas flights made since last July from Atlantic Missile Range. The General Electric developed guidance system includes tracking beacon (black box, upper right), flush-mounted antennas (white stripes), rate beacon (below antennas) and decoder (black box to left of antennas). Tracking beacon and decoder convert command signals received via ground tracking radar into steering commands for Atlas autopilot. Rate beacon is used to establish missile's velocity by means of doppler shift to determine engine cut-off point.

THE PROBLEM:
Development of a new, highly reliable rocket propulsion system

IN FINDING A SOLUTION:

2 HEADS ARE BETTER THAN 1

BUT ARE...

4 BETTER THAN 2?

8 BETTER THAN 4?

16 BETTER THAN 8?

32 BETTER THAN 16?

64 BETTER THAN 32?

128 BETTER THAN 64?

At United Technology Corporation, the old adage—"two heads are better than one"—is viewed with respect.

But it also is recognized that at some point, too many can cause excessive administrative detail, confusion, and red tape which increases the difficulty of finding the solution to the original technical problem.

The emphasis—corporate philosophy—at United Technology Corporation, therefore, is on quality—capacity of mind, talent and experience, rather than on sheer numbers of people. This approach permits the maximum percentage of scientific and engineering man-hours to be devoted to the analyses and experimentation required to obtain the best answers to the technical problems at hand.

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FIRST TO MEET **MS 21042** AND **NAS 1291**

SPS FN-12 Featherweight locknut replaces NAS 679 and equivalents*—saves up to 72% in locknut weight

SPS FN-12 Series Featherweight locknut was the first to meet new MS 21042 calling for a lighter weight replacement for NAS 679 sheet metal nuts. New forged featherweight offers major weight savings, superior performance, high reliability; also permits secondary weight reductions through use of narrower bolting flanges.

Here is the only nut series that meets the new MS 21042 standard, calling for a lighter weight locknut that can universally replace the heavier-type AN 363, MS 20364, MS 20365 and MS 21040 Series.

The new SPS FN-12 weighs as much as 60% less than NAS 679 sheet metal nuts and counterparts . . . up to 72% less than equivalent MS or AN types.*

The FN-12 saves weight in another way also. Because of its new configuration, it can be installed closer to vertical bulkheads than any other aircraft nut now in use. This allows a narrower bolting flange, with consequent reductions in aircraft weight.

You can specify FN-12 Series Featherweight locknuts in 11 sizes. All are available for immediate delivery—you get what you order without delay. And all sizes of the FN-12 locknut—#4 through ⅝ in.—are lower in price than the NAS 679 locknuts.

For more information, write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Request Bulletin 2426.

ACTUAL WEIGHTS OF FN-12 AND COMPARABLE LOCKNUTS

All Weights Expressed as Pounds per 1000 Pieces

Size	FN-12	NAS 679†	% Weight Saved by FN-12	AN Series‡	% Weight Saved by FN-12
#4-40	0.4	0.8-1.0	50%-60%	1.3	69%
#6-32	0.7	1.3-1.7	50%-60%	2.5	72%
#8-32	1.2	2.1-2.5	43%-52%	4.2	71%
#10-32	1.6	2.5-2.8	40%-47%	4.6	67%
¼-28	3.5	3.9-4.7	12%-26%	8.5	59%
⅜-24	5.4	6.4-7.2	16%-25%	11.8	54%
⅝-24	7.3	9.3	21%	19.5	63%

†Range of four most commonly used sheet metal nuts of NAS 679 type
‡Range for AN 363, 364, 365

*MS 20364, MS 20365, MS 21040; NAS 1021, NAS 1022; AN 363, AN 364, AN 365 and AN Plain Nuts

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and gimbal provide, Honeywell has come up with other gyro applications where use of ceramics pays off.

Construction of the stator field windings is an example. Instead of using the conventional epoxy resin to insulate individual laminations of the field winding, Honeywell employs thin strips of ceramic. The field winding is wound with ceramic coated wire instead of the usual enamel or epoxy coated. When the stator has been assembled, it is fired into what amounts to a ceramic encapsulated subassembly. (Ceramic is subsequently removed from field poles by a machining operation.)

This not only provides a more rugged construction, but gives the stator winding far greater dimensional stability at extreme temperatures. It also permits use of an acid for cleansing the entire unit of contaminating particles.

Ceramic castings are ground to approximate size while in a "half-fired" state, then polish-ground to final dimensions and finished using diamond compounds.

Honeywell says its new ceramic gyro can withstand shocks of 30g without bottoming when gyro rotor is spinning, making it suitable for missile and space vehicle use.

Despite the ceramic gyro's greater accuracy, Honeywell believes that it will sell for approximately the same price as a conventional miniature integrating gyro when new unit is in full production. Initial engineering samples, however, will be more expensive. Company spokesman says the ceramic gyro may eventually cost even less than one using conventional construction because of less criticalness in assembly procedures.

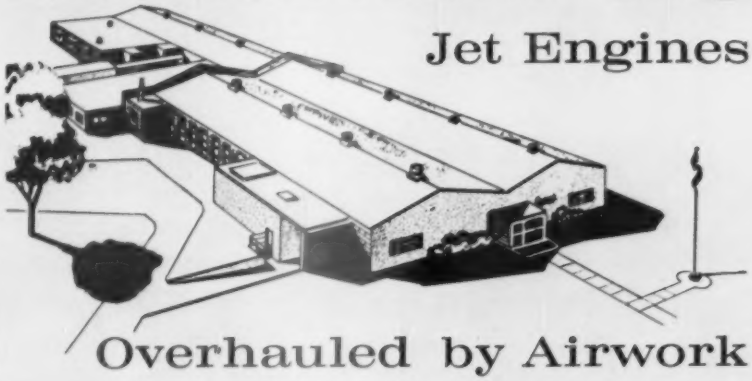
The new ceramic construction and gas bearing techniques are expected to form the basis of a new family of gyros at Honeywell. Current work there on new gimbal support techniques, aimed at reducing another source of gyro error, should produce higher accuracy gyros in the future, a spokesman indicates.

Michigan Offers Courses In Oscillators, Amplifiers

Two consecutive one-week courses in solid-state microwave amplifiers and oscillators, including Masers, diode and ferrite parametric amplifiers, are being offered by the University of Michigan during the last two weeks in July. Staff for the courses will include members of the university staff supplemented by Benjamin Lax and James Meyer, Lincoln Laboratory, Nicolas Bloembergen, Harvard University, E. Schulz-DuBois, Bell Telephone Laboratories and Max Weiss, Hughes Aircraft Research Laboratory. Requests for information regarding registration should be addressed to George Makhov, Bldg. 41, Willow Run Laboratories, Ann Arbor, Mich.

Soon-From This New Shop

Jet Engines



Overhauled by Airwork

By the time you read this, machine tools will be moving into the new shop and most of our lead men will have had their training in the Rolls-Royce factory. By early July, we will be overhauling Dart engines.

This shop, and its three related additions to our Millville plant, are designed to produce jet engine overhauls to the highest precision standards. We are constructing a dynamometer-type test cell to provide the most accurate pre-flight test of engine conditions available, independent of varying atmospheric conditions.

At the same time, a new 13,000 square foot addition to our Miami Jet Accessory Overhaul Shop has been completed, more than doubling the available working area.

When you need a top quality jet engine or accessory overhaul, Airwork will be ready to serve you . . . with the extra quality that is part of our aviation tradition.

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Day by day the Polaris missile gets nearer to its first submarine test firing... nearer the day when, operational, it will become one of our nation's most formidable deterrents to aggression. For with submarines serving as mobile missile launching pads, any target on earth is within deadly striking range if retaliation becomes necessary.

The Polaris-launching submarines are splendidly fitted out not only to aim and fire and accurately guide the missile, but also to defend themselves. Advanced Sperry submarine equipment contributes to both these functions. For precise navigation there is SINS (Ship's Inertial Navigation System), automatic steering and stabilization, depth detectors, gyrocompasses, diving and maneuvering controls, instrumentation, and computers... and the NAVDAC computer which correlates all navigation data. For anti-submarine warfare the subs have Sperry torpedo fire control systems, sonar sub detection equipment, the attack periscope itself. At two special laboratories both aspects of the Polaris program are being refined and integrated: one of which simulates submarine navigation, the other the environments of the sea.

Sperry's role in the Polaris program is typical of the Company today, achieving through specialized divisions an integrated capability that is contributing to every major arena of our environment. General offices: Great Neck, N. Y.

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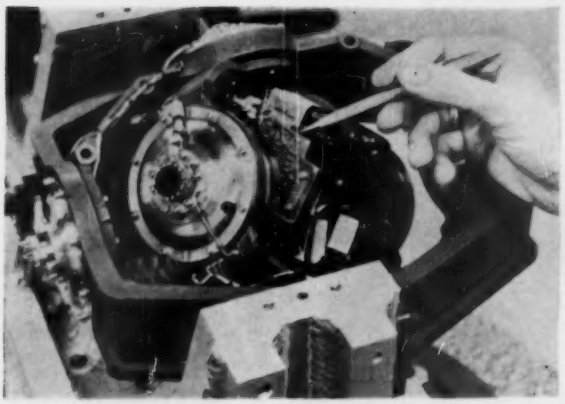
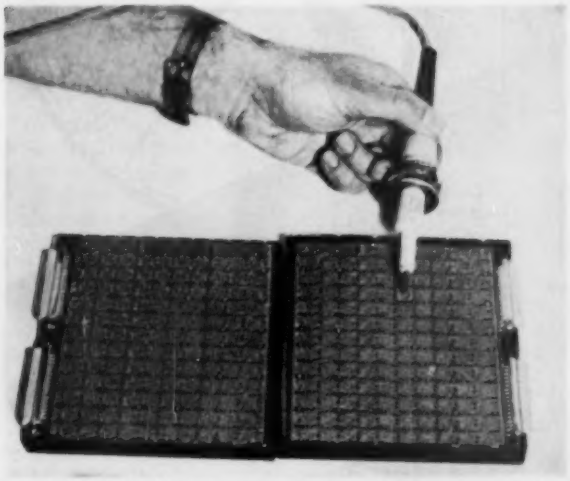
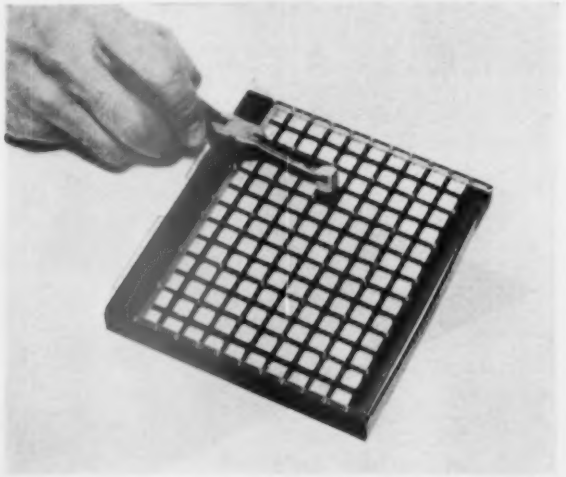
SPERRY



INERTIAL GUIDANCE SYSTEM (left) weighs 44.5 lb., uses Army/RCA micromodules for stabilized platform amplifiers. Right photo compares two resolver amplifiers of conventional miniature construction (left) and two of micromodular construction (right).





DIGITAL GUIDANCE COMPUTER (left) also uses Army/Radio Corp. of America micromodules. Complete guidance computer, including memory, weighs only 4 lb. Photo at right shows "egg crate" construction of digital computer. Micromodules slip into compartment containing corrugated metal sleeve which provides shock isolation and carries off heat.

Inertial System Contains Micromodules

Burlington, Mass.—A complete inertial guidance/navigation system which weighs less than 45 lb.—only 50% to 60% the weight of systems with comparable performance—has been developed here by Radio Corp. of America's Missile Electronics and Controls Division. A four-gimbal platform version weighs about 44½ lb., a three-gimbal model weighs about 3 lb. less.

RCA has been able to slash the weight, size and power consumption of its new inertial system through the use of micromodules, developed by the company under Army sponsorship. This marks the first use of micromodules in equipment intended for avionic application.

The RCA system, now undergoing test, is expected to provide a circular error probability (CEP) of one nautical mile per hour when used on an aircraft that flies at 300 kt., or 0.1% of total range when used in a ballistic missile, the company says.

The complete system, including platform, computer, power supply and cockpit display, occupies 0.82 cu. ft. and consumes 225 watts of electric power.

Micromodule Features

The most novel features of the RCA system are found in the micromodule construction of the digital computer and the stabilized platform amplifiers and control circuits. The design of the platform is comparatively conventional.

The complete navigation-guidance computer, constructed from micromodules, employing a ferrite core memory, occupies a volume of only 0.05 cu. ft., and weighs 4 lb. Power consumption is 12½ watts. The micromodules are mounted in a metal frame which resembles an egg-crate, then soldered to a printed-circuit backplate. Two such frames, each accommodating 130 micromodules, make up the computer arithmetic unit.

Each micromodule is surrounded by a corrugated metal sleeve which serves both as a shock isolator and as a means for transferring heat from the module to metal bars and then to the frame which serves as a heat sink. To facilitate replacement of a defective module, RCA has developed a small fixture which makes it relatively easy to unsolder module leads from the backplate, after which it can be slipped from the egg-crate frame.

By mounting the amplifiers and control circuits required for platform stabilization directly on the inner gimbal, it reduces by about one-half the number of sliprings that would be needed if amplifiers were external to the platform. Signals which must be transmitted to the external computer can be amplified

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GRAPHITAR®

(CARBON-GRAPHITE)

FOR HIGH TEMPERATURE APPLICATIONS

Culminating five years of intensive research, engineers of The United States Graphite Company have developed a new oxidation resistant GRAPHITAR. In exhaustive tests, GRAPHITAR parts were exposed in an oxidizing atmosphere (air) at 1200 degrees F and after 200 hours, the GRAPHITAR showed a weight loss of less than six percent!

GRAPHITAR, which is available in many grades, is a versatile engineering material with unusual and outstanding properties that make it ideal for tough applications. It is non-metallic, resists chemical attack, has self-lubricating properties and a low coefficient of friction. It is mechanically strong, lighter than magnesium and is the perfect material for packing rings, pressure joint seals, clutch release bearings, fluid coupling seals, piston rings, pump liners and vanes.

For more information on this new oxidation resistant GRAPHITAR and its applications, write the GRAPHITAR product manager on your company letterhead.

R-279-1

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before passing through the sliprings to greatly reduce the problem of stray pickup.

The amplifiers required for all three axes of the platform, plus temperature controls, are built into a micromodule assembly which weighs 1¼ lb. and occupies 0.01 cu. ft. Entire assembly can be quickly replaced for maintenance.

The basic computer and amplifier designs were developed by RCA's Missile Electronics and Controls Division here, using conventional components and construction. These designs were then turned over to the company's Semiconductor and Materials Division, Somerville, N. J., which developed the equivalent micromodule circuitry and elements.

The stabilized platform is available in either a three-gimbal configuration, weighing 21½ lb., or a four-gimbal design which weighs 24½ lb., excluding the 1¼ lb. of gimbal-mounted avionics. Platform presently is designed to use Minneapolis-Honeywell or Kearfott miniature integrating gyros, with angular momentums of the order of 5 x 10^6 gram-centimeters squared per second, but can be adapted to other gyro designs, RCA says.

Present platform design employs three Kearfott restrained-pendulum type accelerometers in which displacement of the seismic mass by an applied acceleration produces a pickoff signal which is amplified, then applied to a torque coil in the accelerometer to restore mass to its original position. When the accelerometer is nulled out, the magnitude of the current flowing through the torque coil is a direct function of the applied acceleration and therefore can be used as an output signal.

For applications where an integrating accelerometer or digital output is desired, a pulsing technique can be used to produce the restoring torque on the accelerometer mass. The accelerometer pickoff signal drives a pulse-producing circuit and the number of pulses required to null out the mass is a direct measure of the integral of acceleration, i.e., velocity.

The platform employs direct-drive torque motors rather than servo motors and gearing. Pancake-type synchros are used to pick off deflection angles of the several gimbals relative to one another. Temperature stabilization of the gyros is accomplished by enclosing them in a housing with an internal blower motor and using thermostatically controlled valves to regulate the temperature of the circulating air.

RCA, which developed the new micromodularized inertial system with company funds, currently is showing the system for prospective customers. Company spokesmen say at least one specific application is in immediate prospect.

★ *Positive Mechanically Locked Stem*
★ *Flush Fracture (No Stem Trimming)*
★ *Strong Clinch*
★ *Wide Grip Range*
★ *Positive Hole Fill*

The Cherrylock* "2000" Series Locked Stem Rivet offers every feature desired in an aircraft blind rivet . . . proven high sheet clamp-up with no stem trimming (fractures flush on installation), uniform head seating, complete hole-fill, wide grip range, and positive mechanically locked stem.

Fast, economical, easy installation (with no stem trimming) is available with Cherrylock rivets, using existing Cherry installation guns. You get better fastening at lower installed cost.

One rivet can be used for several material thicknesses, reducing stock requirements and lowering costs. Positive hole-fill, even in oversized holes, simplifies preparation problems to further reduce installation costs. Available in:

A-286 Stainless Steel—Monel—Aluminum

For technical data on the new Cherrylock "2000" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157-N, Santa Ana, California.

*Patent Pending

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Electronics: key to the

secret sea

The problems posed in developing an effective Anti-Submarine Warfare System require the development of entirely new concepts in the broad field of electronics.

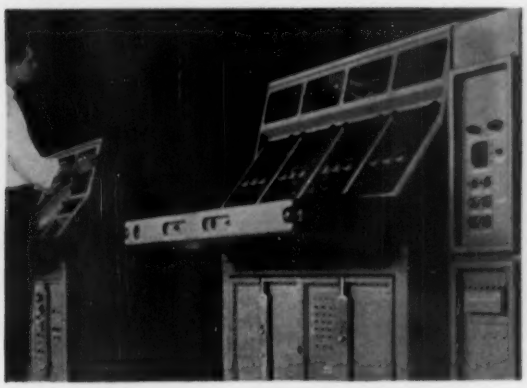
Applying electronics skills toward each of the many elements of the problem is only part of the job. The real key is in the integration of these elements into total systems that effectively solve the problems of ASW.

Working with the Navy, Hughes has instituted a complete systems analysis or "information environment" approach. This Hughes "systems orientation" draws upon unique abilities acquired in the development of such Hughes systems as: airborne electronics armament systems, which can control an entire mission; 3-dimensional radar systems, which constitute the most important advance in the state of the art since radar itself was invented; Falcon guided missiles, which are the most advanced weapons of their type—just to name a few.

Rather than taking standard approaches to the ASW problem, Hughes engineers are using a wide variety of electronic disciplines. Studies presently underway include: research in acoustic array systems (both fixed and mobile); radar and IR detection systems; magnetic anomaly detection systems; information, command and controls systems for strategic decision-making and for tactical operations; communications systems; signal recovery techniques; human factors studies.

Foresight, imagination, tested and proven management capability—these are the factors which insure successful Hughes systems implementation. For further information concerning the Hughes "information-environment" approach, please contact: Mr. D. R. Heebner, Underseas Warfare Mission Coordinator, Hughes Aircraft Co., Fullerton, California.

This simulated Navy Combat Information Center uses Hughes advanced information and display systems to unite hundreds of pieces of surveillance data into a meaningful total.

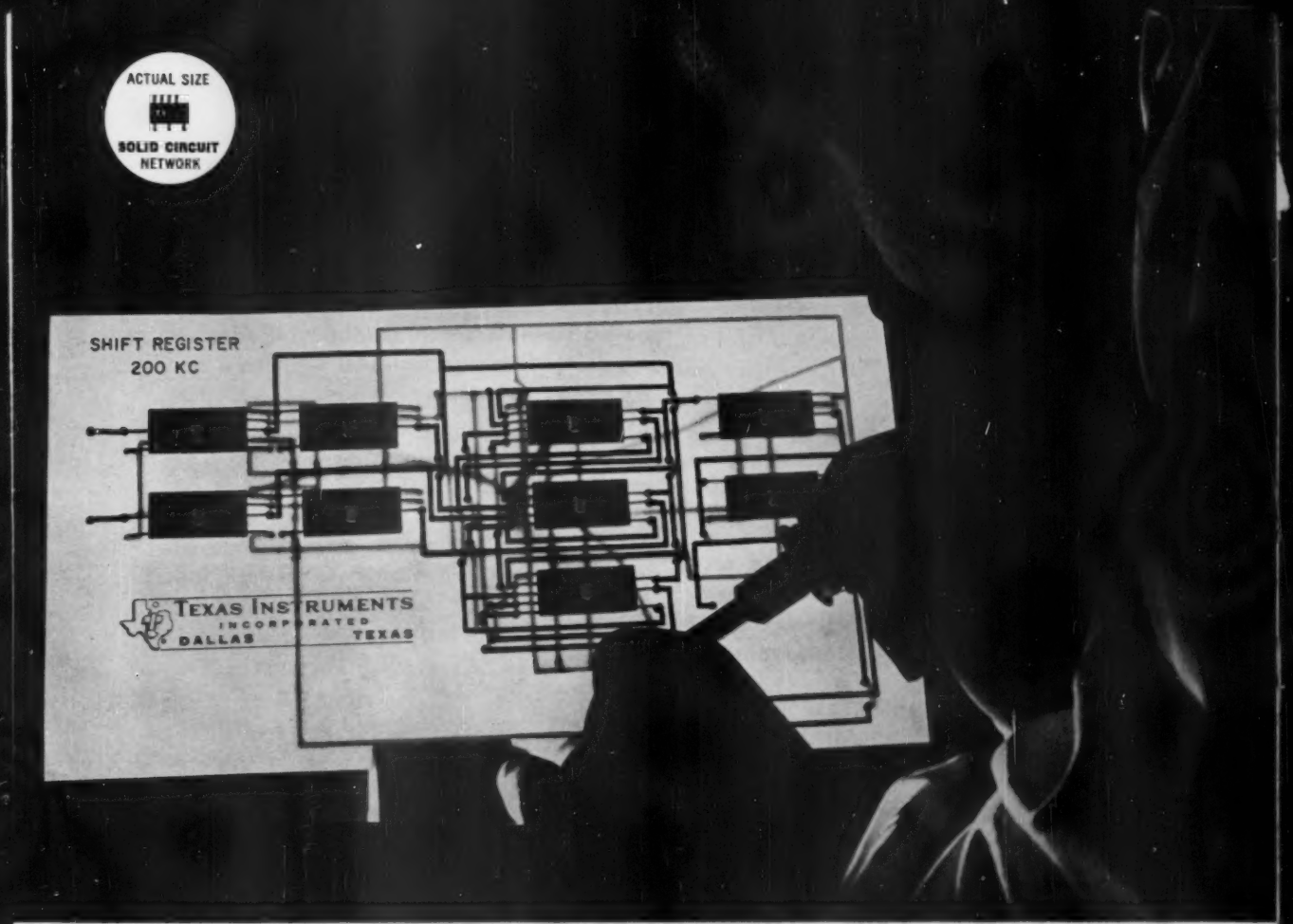


To study ultrasensitive infrared systems for ASW, Hughes engineers have developed this prototype miniature super refrigerator which cools sensitive elements to temperatures as low as −260° C.

Creating a new world with ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo, Fullerton, Newport Beach, Malibu, Oceanside, Santa Barbara and Los Angeles, California; Tucson, Arizona



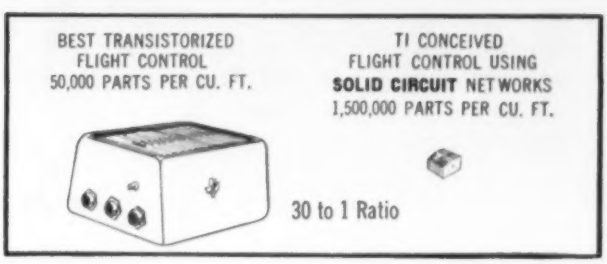
TI is now developing revolutionary missile electronics using SOLID CIRCUIT* semiconductor networks

In 1959, four years ahead of industry expectations, Texas Instruments introduced *Solid Circuit* semiconductor networks . . . a new concept for harnessing the functions of a complete circuit in a single crystal silicon wafer no larger than the head of a match.

Now, system designers in TI's Apparatus division are applying this concept to digital flight control problems — and the result is minimum 30-to-one size reduction over the highest-density packaging previously available. Equally important is an 80% reduction in the number of solder joints — a major cause of electronic equipment failure. Apparatus division experience in this new concept indicates that nearly half of today's military electronics, ground or airborne systems, can make practical, beneficial use of *Solid Circuit* networks.

Other reliability gains attributed to this new design concept evolve from simplified production, test and process control. Equipment fabrication steps already have been reduced to one-tenth those needed for the same circuit functions using conventional components. Where unprecedented long-term reliability is required such as in space flight, the weight and space consumed by conventional components can now be diverted to circuit redundancy and "self-healing" techniques. And in missile/space vehicle design these new space and weight savings mean that fuel load can be increased without displacing valuable instrumentation.

The application of this advanced technology is another example showing how TI puts new concepts to work in military electronic systems. For more information on TI capabilities, send for booklet "Missile Electronic Systems" or contact SERVICE ENGINEERING.



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APPARATUS DIVISION

Interest Grows in Cryogenic Techniques

By Barry Miller

Washington—Interest in cryogenic techniques, especially thin superconducting films, for computing systems appears to be on the upswing, a recent three-day symposium held here on this topic indicates.

Sponsored by the Information Systems Branch of the Office of Naval Research, the meeting brought together about 400 scientists and engineers from this country and abroad for an exchange of views on the technical status and problems of superconductivity, and to a lesser degree, other cryogenic techniques and devices which may have application in information processing systems.

Superconducting Devices

Superconducting devices for computing systems are enjoying a modest revival, a number of scientists attending the symposium told AVIATION WEEK. After an initial flurry of industry enthusiasm, stimulated by the late Dudley Buck's suggestion for the cryotron—a small, low-power superconductive switch—interest in these devices dwindled.

A few major companies, however, partly with government support, but substantially through company-funded programs, continued to work at the problems associated with superconductive computing devices. These problems, which have consumed substantial research effort, include the need for better understanding of superconductivity, for sharp transition materials, for the development of suitable superconducting circuits, and with the turn from wire-wound to the more promising film devices, the need to control and understand vacuum evaporation in order to adequately obtain quality, reproducible thin films.

It now appears, this reasoning continues, that the promise of cryotrons, and perhaps a few other superconductive thin film devices, will be realized, although not imminently. The anticipated advantages of these devices are:

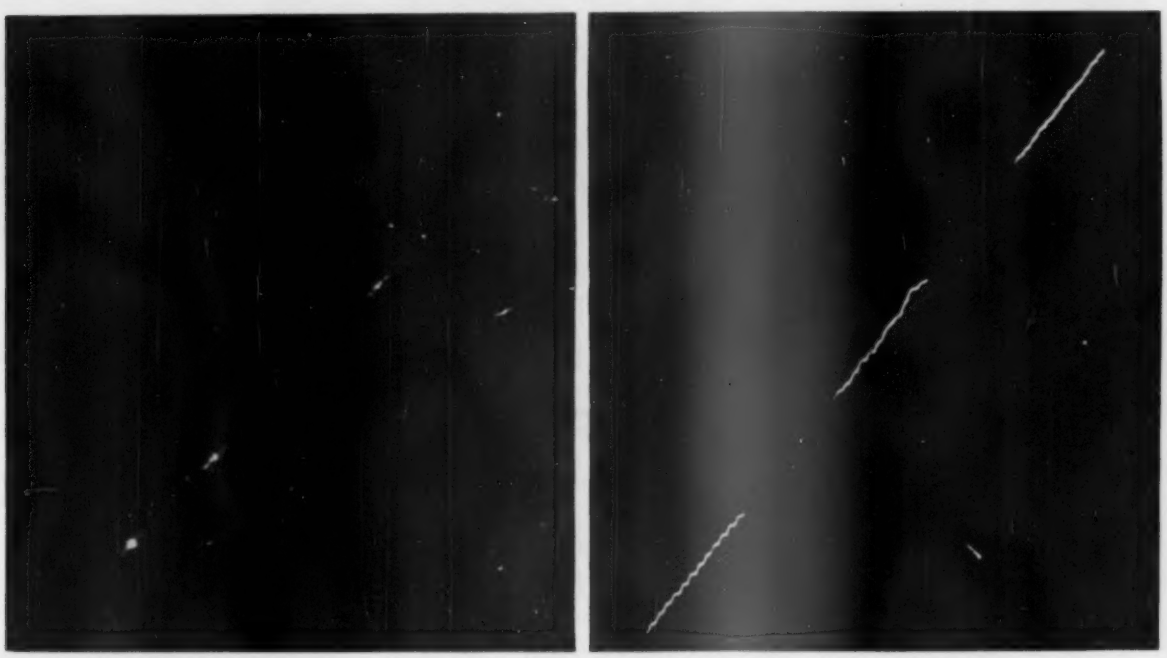
- **Low cost.**
- **Extremely small size** with very little power dissipation. Packing densities up to 40 million devices per cubic foot were mentioned.
- **Ease of fabrication.**
- **Expected high yields.**

Recent Devices

Besides cryotrons, a few of the other devices described or suggested at the symposium were:

- **Calotron,** a multistage switching element. This simple superconducting device, said to be capable of switching from one state to another in 10 nanoseconds, was suggested by E. H. Rhoderick of the Services Electronics Research Laboratory, Baldock Hertfordshire, England.

Operation of this element is based on the existence of a stationary bound-



Satellite Photos Clarified

Corkscrew pattern in photographs of Russia's 5-ton spacecraft launched May 15, first interpreted as indication of tumbling (AW May 23, p. 27), now are analyzed as the result of camera mount vibration. Contrast is apparent between real tumbling of rocket case (right) shown by alternate bright dot and faint line trailing off, and satellite itself (left). Grumman's tracking station analyzed the satellite pattern as the result of 24 and 29 cycle vibrations from the building on which the camera was mounted, possibly from machinery in the building itself. The 24 cycle vibration since has been eliminated by insulating the mount, and the 29 cycle has been damped. One question raised was that both satellite and rocket case were photographed on the same negative, though at different times. Grumman engineers feel the building vibration may have stopped after the satellite passed, thus eliminating the corkscrew pattern on the rocket case picture. Any doubts, Grumman felt, were resolved in computing the presumed length of the satellite by measuring the amplitude of the frequency; these show the vehicle would be 425 ft. long. The pattern was not detected in earlier pictures taken by the tracker since these photos had not been enlarged. Rechecking the pictures disclosed the vibration pattern was discernible on them with sufficient magnification applied.

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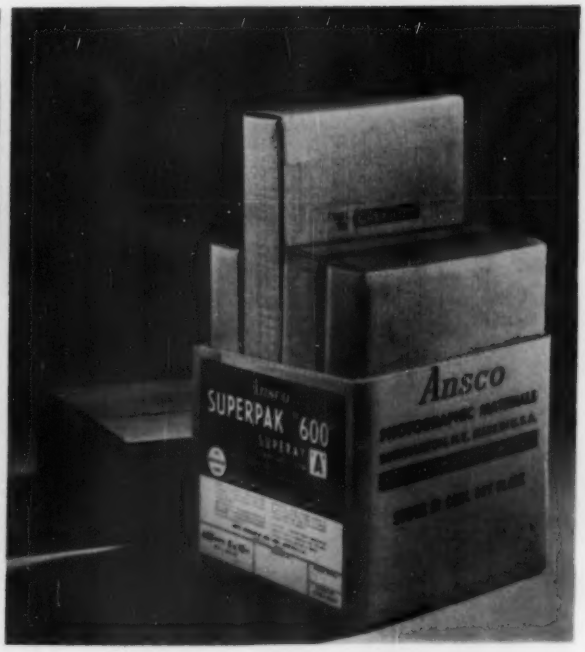

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From every point of view; money, time and general efficiency . . . it makes sense to use SUPERPAK. Ansco, Binghamton, N. Y., A Division of General Aniline and Film Corporation, Manufacturer of World Famous Superay X-ray Films.

ary between the normal and the superconducting state in a thin film at a specific current level. A bistable element could consist of a thin film carrying a standing current which maintains the boundary. An ignition pulse of the same polarity as the standing current is sufficient to push the film into the normal state and hold it there because a current smaller than the film's critical current can maintain the boundary. An opposite polarity extinction pulse can cancel the standing current long enough for the film to become superconducting again.

This work, Rhoderick explained, was performed with tin and lead films of 500 to 600 angstroms thickness. Three mil square elements were made. Their disadvantage he conceded, is the 100 microwatts dissipated in the ON state. About 10,000 calotrons could be employed without excessive liquid helium boil off, he indicated.

• **Microwave switches** for possible use in ultra-high-speed computers. Experiments which, if successful, could lead to inexpensive, broadband microwave devices operating up into the K band are in progress at Sperry Gyroscope Co., David Abraham told the meeting. Work now under way is attempting to observe switching in X band (9 kmc.).

With very thin films, ranging in thickness from 20 to 100 angstroms, Abraham and coworkers devised an experiment to determine if the superconducting film could switch repetitively at 9 kmc. under the influence of a microwave field. The thin film will be used as a probe in a waveguide to coaxial transition section. Properly oriented the film is exposed to peak values of the microwave field in the waveguide and has a uniform field across its width. If switching occurs, the coupling of energy into the coaxial would change radically four times a cycle causing substantial second harmonic generation which can be detected.

In earlier work thin films were used to terminate a coaxial transmission line. In the normal state, the film had the characteristic impedance of the line; in the superconductive state, it shorted the line. Time required to switch from one state to the other was measured at 0.15 nanosecond.

The Sperry work was supported by the Navy Bureau of Ships, as part of what is understood to be Project Lightning, the Navy's large research examination of ultra-high-speed or microwave computers.

• **Continuous sheet** superconductive memory. A continuous sheet superconducting memory in which persistent current is used for storage and coincident current for selection was described by L. L. Burns of Radio Corp. of America's David Sarnoff Research Center. The memory employs a continu-

Eliminates Instrument Interference!

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NON-MAGNETIC PROPERTIES . . . "NO-MAG" cable is made from type 305 stainless steel. It remains non-magnetic after severe cold working —in contrast to standard stainless steel aircraft cable which shows a pronounced increase in magnetism after swaging, wire drawing or similar operations.

This non-magnetic property of "NO-MAG" cable eliminates instrument interference from cable magnetism.

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TENSILE STRENGTH, while lower than that of stainless and carbon steel, is sufficient to enable replacing these, size for size, with "NO-MAG" on many applications where the characteristics of "NO-MAG" are required.

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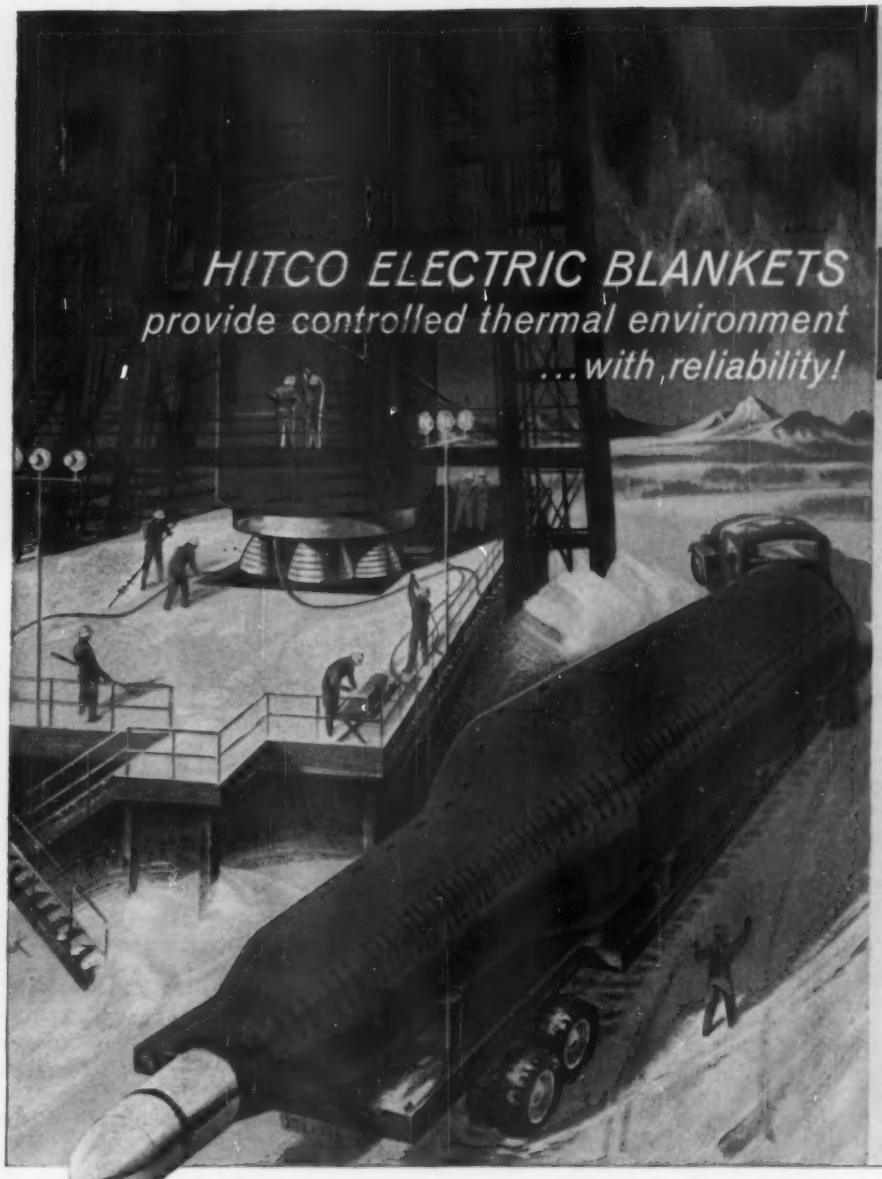
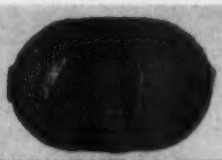
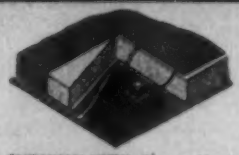


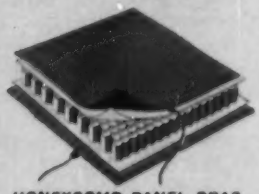


TYPICAL ELECTRIC BLANKET. This is a HITCO "form-fitting" Blanket used to control temperature of hydrogen peroxide tank.

...FOR TEMPERATURE EXTREMES
−65° to
+2200°F



CUTAWAY VIEW. Shows Heating Element of HITCO Electric Blanket—sealed between cover and inner cover.



HONEYCOMB PANEL BRAZING. New HITCO Electric Blanket brazing technique provides faster, more reliable means of fabricating honeycomb structures.

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Controlled Thermal Environment prior to launch is vital to the flight success of a multi-million dollar missile. In many other industries, controlled heat is just as important.

Hrrco Electric Blankets are designed to provide safe, reliable control of temperatures in a wide range from −65° to +2200°F. Hrrco R&D is now developing electric blankets which will be capable of controlling ultra-high temperatures beyond the 2200°F range.

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ous superconducting film for persistent current storage. Film cryotrons supply the selection logic.

Among reports relating to cryotrons were an analysis of the crossed film cryotron, presented by Vernon L. Newhouse of General Electric; a breakdown of useful circuit design parameters of cryotrons by M. L. Cohen of Arthur D. Little, Inc.; description of a storage and retrieval system using cryotrons and persistent current memory cells by Al Slade of Arthur D. Little, and an analysis of cryotron storage, arithmetic and logic circuits by M. K. Haynes of International Business Machines Corp.

Alan L. McWhorter of Lincoln Laboratory described efforts to build a 4/4 memory array of cryosars with 0.1 microsecond clock rate and 15 nanosecond switching rate. Cryosars are not superconductors, but are switches utilizing impact ionization in semiconductors at cryogenic temperatures. McWhorter said efforts are being made to operate indium-doped silicon at liquid nitrogen temperatures. Other reports at the conference mentioned work on cryosars in England and Sweden.

In another report, Dr. Rolfe E. Glover III, of the University of North Carolina, suggested the possibility of raising, or lowering, the transition temperature—the temperature at which the film passes from the superconducting to the normal states—by electrostatic charging. Temperature changes measured thus far are small, 4 millidegrees with 10 millidegrees appearing possible. In his experiment, Glover deposited thin films of gold, zinc, lead or tin on a mica substrate and placed this atop a conductor to form a parallel plate capacitor.

Charging of the capacitor changes the conductivity of the thin film and measurements revealed that a negatively charged plate increased the transition temperature, positive charges dropped it. From an analysis of thin superconductors at microwave and infrared frequencies, Glover suggested choppers, harmonic generators and infrared detectors as possible applications for superconductors.

Films free of edge effects, which broaden magnetic transitions in evaporated films, can be obtained by deposition on very clean or heated substrates or the film edges can be removed mechanically or by etching, R. B. DeLano, Jr., said in an analysis of edge effects in superconductors. Gate films with broad transitions make poor cryotrons.

Each of the reports presented at the meeting is to be included in the symposium proceedings, which will be published as an Office of Naval Research report in about two months, and will be made available subsequently through the Department of Commerce's Office of Technical Services.

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Long before World War II he solved problems in such diverse fields as gyrostabilized platforms and aircraft instrumentation, guidance and control systems. More than 50 patents in those fields have been issued in his name.

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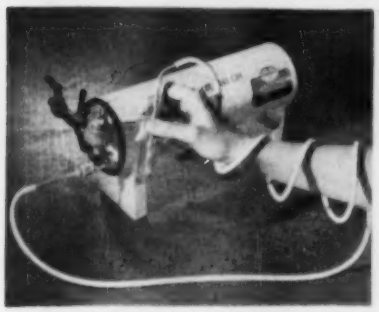
▶ **Plasma Radar Detector**—S-band plasma radar detector which withstands incident power levels in excess of those which destroy crystal detectors, permits more effective range gating to counter jamming and has sensitivity comparable to that of a crystal detector has been designed at Air Force Cambridge Research Center. Detector employs bottle of noble gas, such as neon or zenon, which illuminates under d.c. excitation. Afterglow, which is a direct function of the rate of recombination of electrons with positive ions of the gas can be altered by reflected energy from radar target. Changes in luminosity are then monitored by photomultipliers. Noise figures for plasma detector are relatively high.

▶ **Neutron Damage to Ferrites**—Magnetic properties of ferrites deteriorate suddenly and rapidly when exposed to radiation dosage of 10^{18} nvt. Up to this value properties appear to degrade linearly with increasing neutron bombardment, according to a Stanford Research Institute study, backed by Air Force Cambridge Research Center. Peculiarly, ferrite's properties improve after bombardment, followed a week later by renewed deterioration, of a more severe nature, than found immediately after bombardment.

▶ **Hoffman Electronics Corp.'s** Semiconductor Division has received a $548,000 contract from Jet Propulsion Laboratory for fabrication of solar panels for the Project Ranger series of lunar spacecraft. Hoffman will fabricate 12 solar panels; each panel will mount 4,340 silicon solar cells and be capable of generating a power output of 95 watts.



Infrared Cooling

Cooling of infrared equipment may be simplified by a method of transmitting liquid nitrogen through uninsulated plastic wires over distances greater than 25 ft. Flexible wires remain frost free and can be handled easily. Work is in progress at the Garrett Corp.'s AiResearch Mfg. Division of Los Angeles.

Signed on the Dotted Line—Major contract awards recently announced by avionics manufacturers include the following:

- **Bendix Corp.** will produce AN/GJQ 9 automatic ground checkout system for the Douglas Skybolt air-launched missile and the North American Hound Dog missile under a $1.5 million contract from the Air Force.
- **AC Spark Plug Division** of General Motors Corp. will research and develop the inertial guidance systems, including ground operating equipment, for the Titan missile under an $84 million contract from the Air Force.
- **Electro-Optical Systems, Inc.,** will develop a tunable, molecular amplifier for Wright Air Development Division under a $83,988 contract. Electro Optical will investigate applicability of various semiconductor and quantum mechanical phenomena.
- **Technical Operations, Inc.,** Burlington, Mass., will study means of improving efficiency of solar cells, and seek ways of enabling solar cells to use a broader spectrum of total energy radiated by the sun. Work is supported by Air Force Cambridge Research Center with a $40,400 contract.
- **Servomechanisms, Inc.,** will produce true airspeed computers for Lockheed Aircraft Corp. under a $309,343 order.

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New binary eutectic structure (250X)

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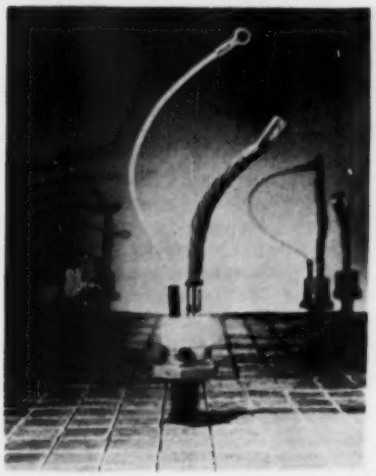
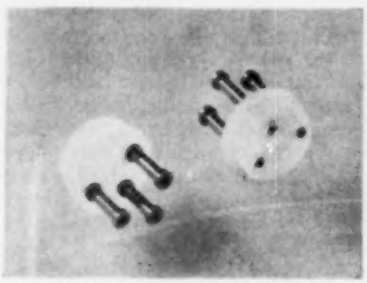
• **Controlled rectifiers,** suited for high power applications up to 300 v. and 50 amp. are available from Westinghouse. Rectifiers have switching times of 600 nanoseconds with 60 to 300 v. peak



reverse voltages. In quantity, orders up to 24 units are priced at $110 to $295 each. For 25 or more units prices range from $85 to $235. Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa.



• **Transistor holders,** TC 300, which are a series of Teflon insulated holders that can accommodate three-lead transistors. Extra long terminals act as heat sinks and permit soldering of transistor in place with less danger of damage to semiconductor. Sealectro Corp., 139 Hoyt St., Mamaroneck, N. Y.

• **Servo amplifier,** solid-state device designed to drive size 11, 40 v. center tapped servo motors used in 115 v., 400 cps. servo systems is available. Gain stability is ±2 db. over −55 to 102C range. Input impedance of 10,000 ohms can be increased with series resistors. Power output is 3.5 watts into 460 ohm effective resistance. Power gain is 90 db. maximum with no feedback or 70 db. min. with feedback. Amplifier weighs 0.63 lb., meets MIL-I-6181B. United Control Corp., 4540 Union Bay Pace, Seattle 5, Wash.

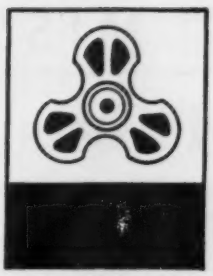
• **Power supplies,** a complete line of high-voltage, low-current transistor-regulated supplies are obtainable with a five year warranty on all components. Line covers voltage ranges from 35 to 325 v., each range in 30-v.; continuously

variable bands, and current range up to 1.5 amp. over entire voltage range. Line regulation is better than 0.1% or 0.2 v., whichever is greater, for input variations from 105 to 125 v. Each model is designed for 19 in. rack mounting. Power Sources, Inc., Burlington, Mass.

• **Video detector microwave diode,** Type 1N31A for use in X band and which meets full range of military environmental tests has been developed. Diode is contained in coax package, is hermetically sealed and has video impedance range of 3 to 17 thousand ohms, according to the firm, Sylvania Electric Products Inc., 100 Sylvan Rd., Woburn, Mass.

• **Chopper stabilized low level** d.c. amplifier, model 759-6, can accept 5 microvolts to one volt signals and provides low-drift, low noise, highly stable and good resolution outputs, according to manufacturer. Unit is suited for laboratory work or for handling thermo-

couple, strain gauge and resistance type transducer outputs, and sells at $199.50 complete with cabinet, handle and panel meter. Without the meter, amplifier can be purchased for $179.50. Magnetic Instruments Co., Thornwood, N. Y.



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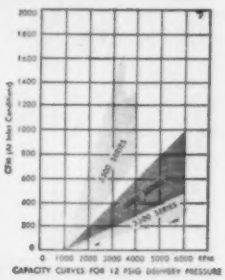

CAPACITY CURVES FOR 12 PSIG DELIVERY PRESSURE

M-D BLOWERS, INC.
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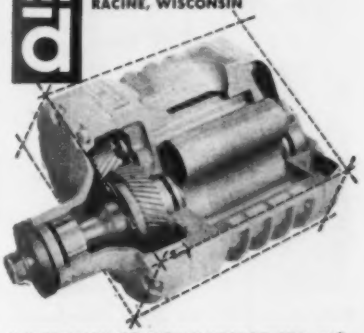

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Kiwi Tests Produce Nuclear Rocket Data

Washington—General performance goals and requirements for a flyable nuclear rocket engine have been generally established following a study of results of the test running of the Kiwi-A experimental reactor last summer.

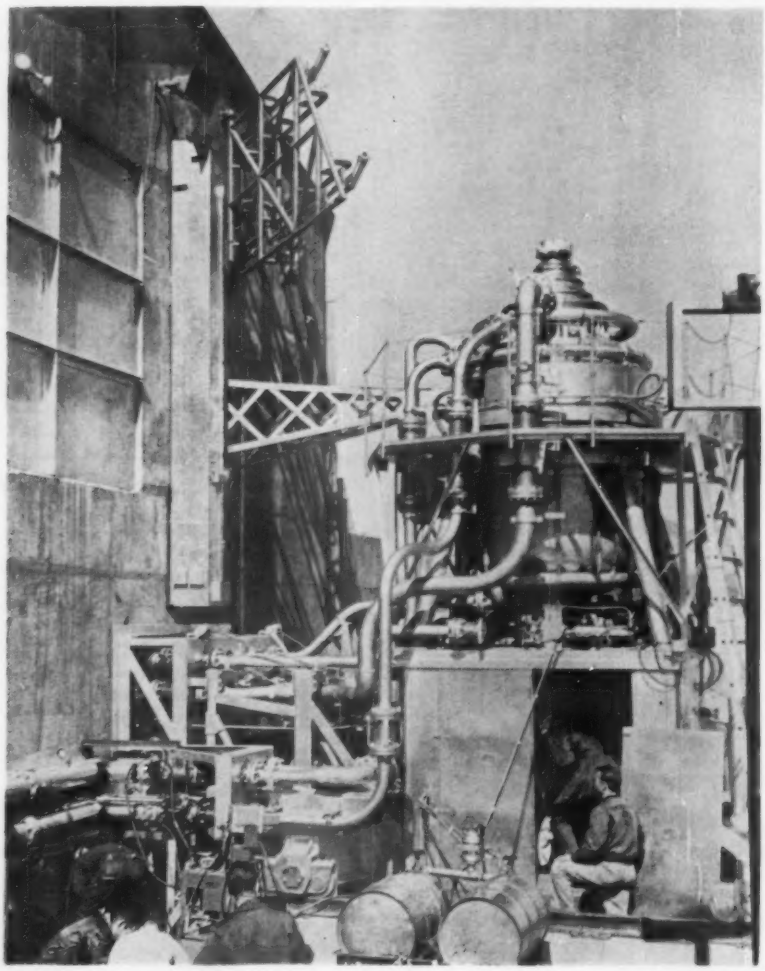
Goals, described by Atomic Energy Commission, Air Force and National Aeronautics and Space Administration personnel as engineering efforts that can be obtained without further basic research, are:

- **First flyable nuclear rocket** will develop approximately 50,000-100,000 lb. thrust and have a reactor power of about 2,000 megawatts.
- **Specific impulse** of the first generation nuclear rocket will be about 800 sec., which requires a maximum temperature of approximately 2,000C. Ultimate specific impulse for a heat exchanger reactor type rocket is expected to be about 1,200 sec.
- **Range of power densities** to be expected on heat exchanger type rocket reactors is 100 to 600 kw. per lb. This is well above the power densities of reactors in use today, but the Kiwi-A tests have shown they are practical when the operating life required of a rocket engine is from 5 to 30 min.
- **Lead time required** by the reactor in a nuclear rocket is below many of the other components of the rocket. The cryogenic pumps, valves, lines, etc., needed for transporting and metering the liquid hydrogen propellant, for instance, have required more development time than have the actual reactors.

Opinion of the technical people in charge of the Rover nuclear rocket program as to the feasibility of a nuclear rocket has been made clear in congressional testimony.

Dr. Ramon E. Schreiber of the Atomic Energy Commission and technical head of Project Rover told the Research and Development Subcommittee of the Joint Congressional Committee on Atomic Energy that the use of heat-exchanger nuclear engines to propel space vehicles appears to be a matter of detailed engineering, money and a determination to carry the project through.

Tests with the Kiwi-A reactor were completed last summer at Jackass Flats, Nev. Tests were successfully completed during the first high temperature operation of the reactor. Purpose of the Kiwi-A test was to operate the reactor at high power and to hold a predetermined temperature level for a period representative of an operational cycle for a rocket engine in space.



KIWI-A, first Project Rover experimental nuclear reactor, mounted on remotely-controlled railway car, is coupled to test cell prior to an experimental run.

Additional Tests Planned

Several short experiments were made before this high power run to check the coolant systems, instrumentation, controls and communications.

On the basis of this first successful running, AEC plans to test two more reactors this summer in Nevada. They are designated Kiwi-A prime reactors and will resemble the original Kiwi-A except for minor changes shown to be desirable by recent testing. Main objective of the Kiwi-A prime tests is to provide some concrete evidence as to the operating life of the reactor and its subsystems by operating them until some positive damage occurs.

Dr. Schreiber, in explaining Project Rover progress to the congressional committee, said the "limited effort" authorized had been applied primarily to the development of reactors. Multiple avenues of reactor design were generally ruled out because of funding problems, and this was the reason for the optimism of AEC personnel when Kiwi-A, their one-shot research step toward a flyable reactor, performed so well under test.

First detailed description of the Kiwi-A reactor and test set-up was recently made by Air Force Lt. Col. Howard R. Schmidt and Maj. Ralph S. Decker who are attached to the AEC's Project Rover.

The reactor weighed more than the

thrust it could produce. A number of compromises were made in the reactor design to keep it simple and to lower costs. Separate circulating water systems were provided for the pressure and nozzle. This avoided the development of regeneratively cooled systems for the "combustion chamber" and the nozzle using liquid hydrogen propellant for coolant. Some heavy water moderation was used in the reactor to minimize fuel volume, costs and propellant flow rate. Externally, simplifications to the test reactor resulted in a large network of pipes that would not be necessary on a flight engine.

Test Process

The Kiwi-A was tested in a nozzle up position and, based upon the success of this experiment, it is probable that most, if not all, nuclear rocket testing will be conducted in this position. Chemical rockets are usually tested with the nozzle down to prevent the collection of propellant vapors or liquids in the combustion chamber and the formation of explosive mixtures. Nozzle-up test attitude eliminates the need for large test towers and exhaust deflection systems.

During the test, the Kiwi-A reactor sat on a box-like structure on top of a railroad car that was physically attached to a test cell building. The box structure housed the control rod drive mechanism and the terminal board for several hundred instrumentation connections. Cooling water and propellant were taken aboard the railroad car through lines connected to tanks in the test cell building area.

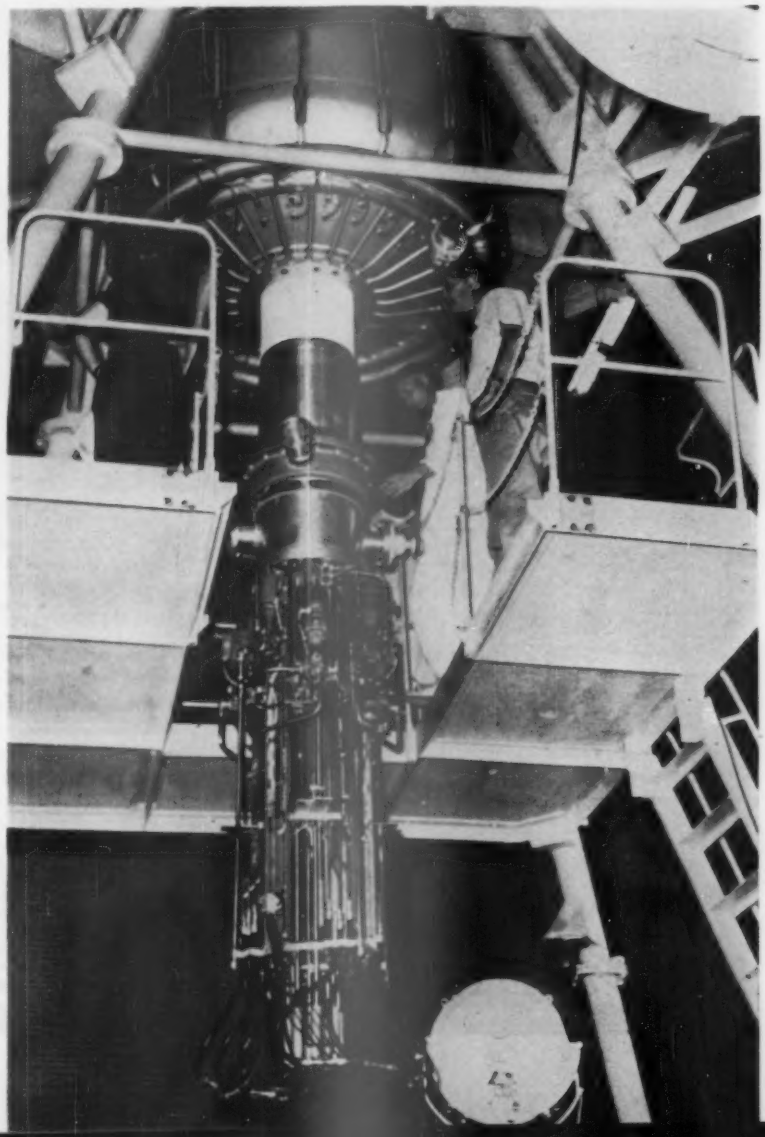
Project personnel were housed in a control building two miles from the test cell. Hydrogen propellant flow was initiated before the reactor began producing power, and it was lighted off with a butane torch. No attempt was made to shield the reactor or to contain fission products either from the reactor or those in the propellant gas. Tests are initiated when the wind is away from the control building, but the two-mile spacing is sufficient to prevent any danger to personnel if the wind suddenly changes.

Maximum fallout of fission products during the Kiwi-A test occurred about a mile from the reactor. They were generally mild because, had a person been standing at that point unshielded, he would have received no more than a one-week acceptable occupational level from all of the fallout effects.

Many off-site measurements were made, and aircraft were flown through the exhaust plume from the reactor. These tests and measurements indicated that reactors of much larger power can be safely tested at the Jackass Flats installation.

The Kiwi-A reactor was transported

SMOKE from JATO bottle rises during first Kiwi-A test at Jackass Flats, Nev. Below, control mechanism for reactor power level is inserted in Kiwi-A prime.



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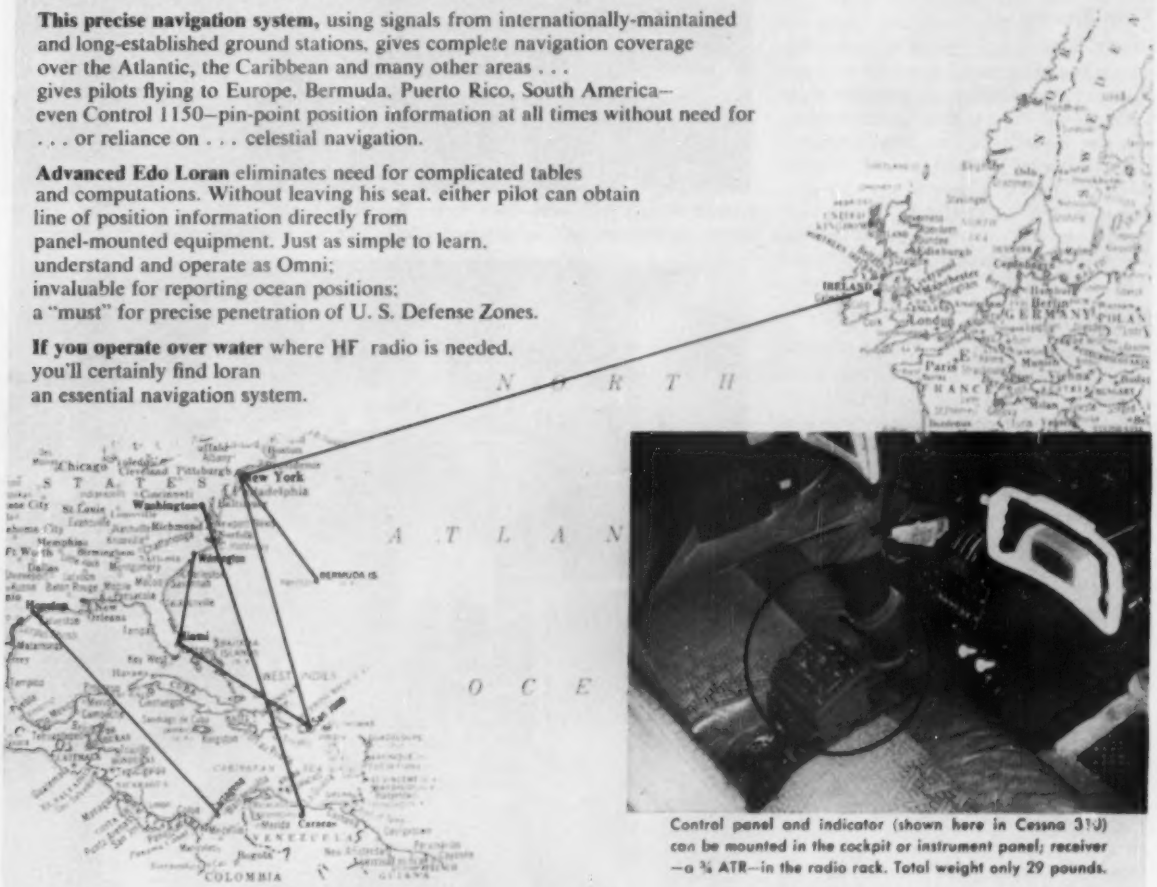

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from its test cell building to a maintenance and disassembly building about two weeks after the test. The locomotive used to make the transfer was shielded, and the disassembly and checking of the reactor parts was performed remotely in a shielded bay.

French Nuclear Plans Decried by General

Paris—French Gen. Jean Valluy, who retired from active service last month, said France should drop its ambition to create a national nuclear strike force and rely instead on integrating its forces with its European allies.

Gen. Valluy, who since 1956 has been chief commander, Allied Forces, Central Europe, does not agree with Gen. de Gaulle's plans to set up a national strike force based on Dassault Mirage IV aircraft or IRBMs.

Composition of such a force, Valluy said in Paris, requires considerable numbers of highly-trained personnel which France, as well as Great Britain, can barely meet. Such force also requires an industrial and research setup which would strain French resources. Noting that the British recently dropped their Blue Streak missile project, Valluy recommended that his country scrap its strike force project as well.

"There is no doubt," Valluy said, "that to create such a force requires cooperation between European nations." Valluy also characterized over-all French military equipment as "obsolete and wornout." French army, largely engaged in Algerian fighting, would be completely devoid of equipment when it finally leaves North Africa, Valluy said.

Turning to NATO military problems, Valluy, who has a reputation as an intellectual, "outspoken" general, said it was highly unlikely NATO Central European forces could stop a Soviet thrust across Central Europe. Russians, he said, have 20 divisions ready to move in East Germany, with another 20 divisions capable of moving into the area. Within 10 days of initial attack Soviets could mobilize 60 divisions. To hold the Central European line against a force this size, NATO needs at least 45 divisions. Yet, Valluy said, NATO Central European forces were far below the established goal of 30 divisions.

On use of tactical nuclear weapons to offset the Soviet advantage, Valluy doubted that such weapons would come into play early in the attack. He stated that no NATO commander, including Gen. Lauris Norstad, Supreme Allied Commander, Europe, could order use of such weapons against a conventional force attack without prior political decision. To get such a decision, Valluy said, each of the 15 NATO nations would have to be consulted.

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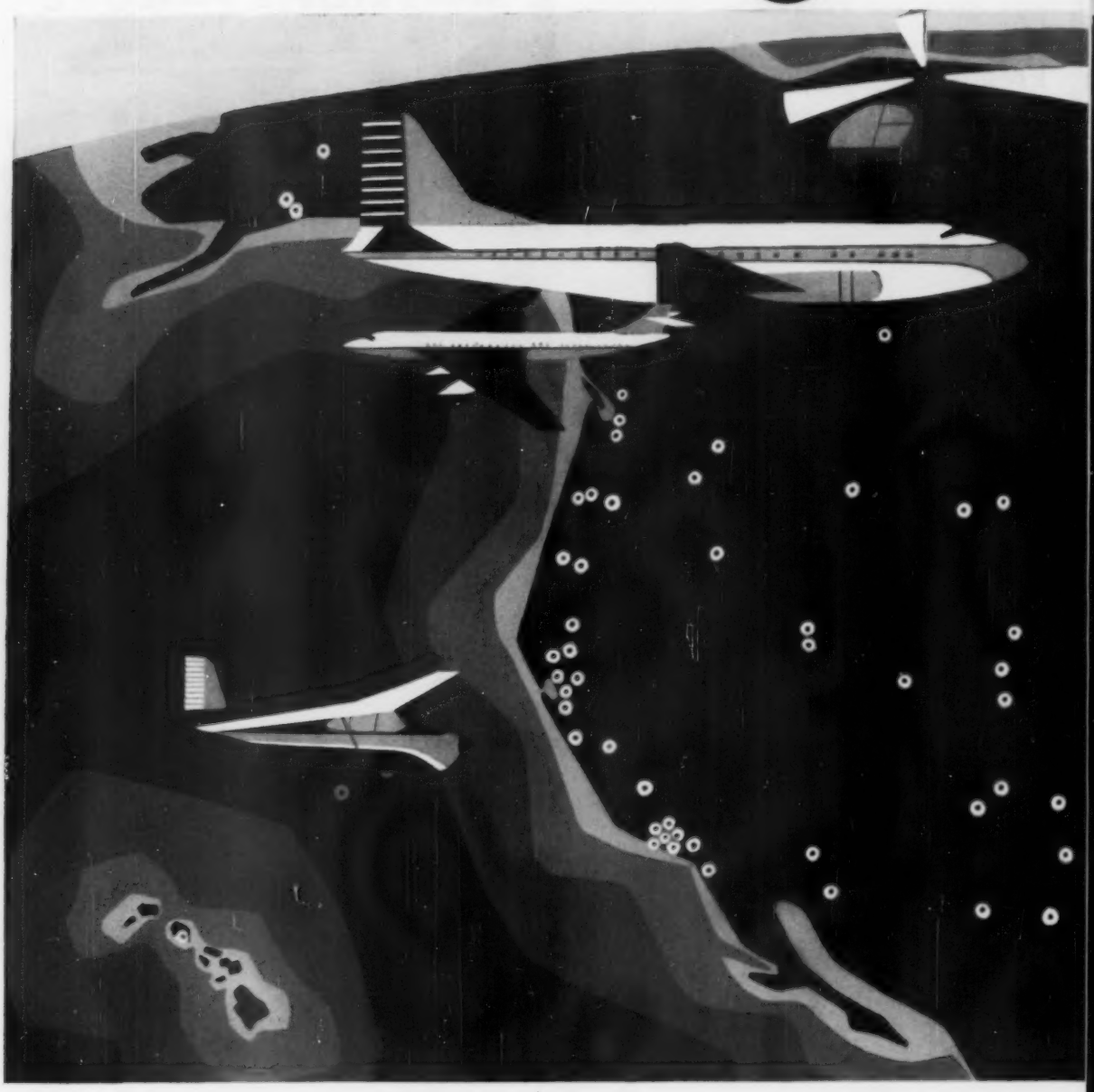

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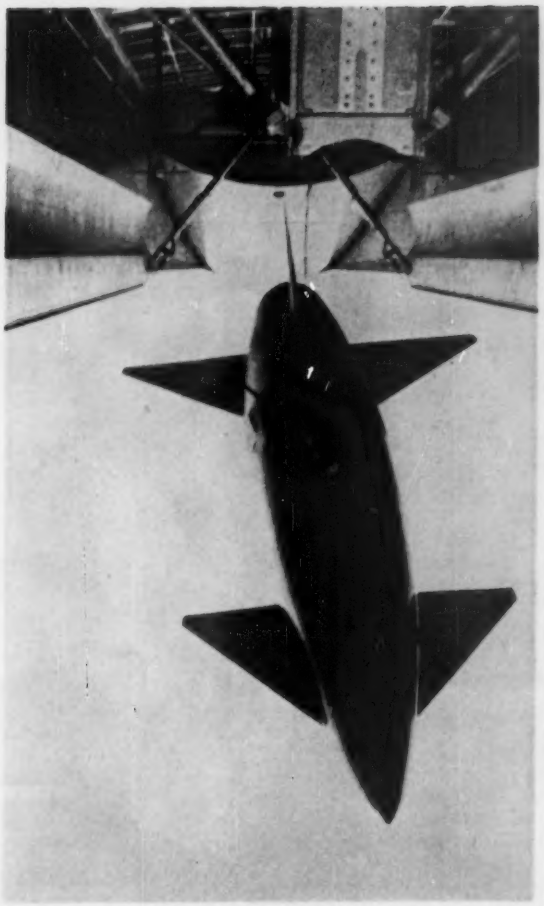

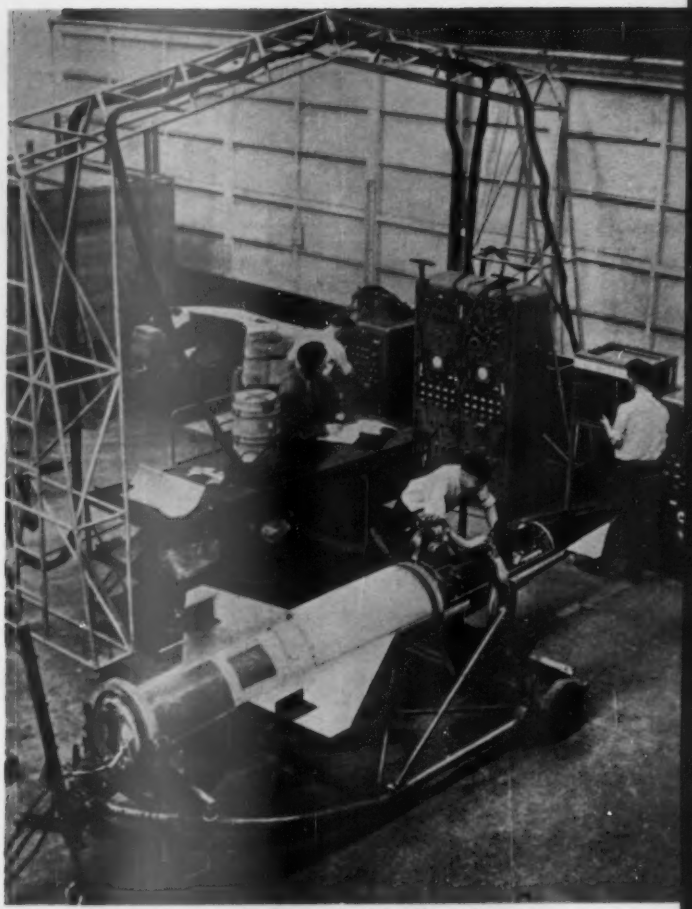

After separation from an Avro Vulcan (left) an Avro Blue Steel Mk. 1 missile follows a flight path programed by the missile's inertial navigation system referenced to the point of separation. At right a Blue Steel undergoes static testing.

British Test Blue Steel Mk. 1 Stand-Off Bomb

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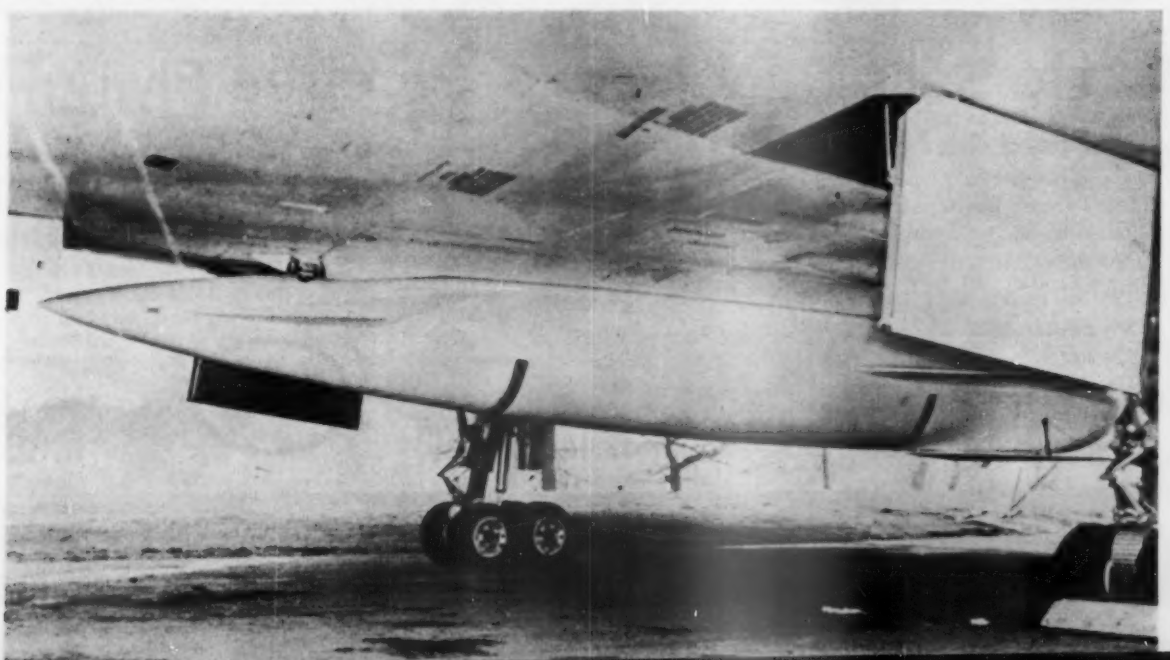

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Chance Vought Tests Field Missile Design

By Richard Sweeney

Los Angeles—A solid propellant missile suitable for short and long range combat unit direct support missions, which has a single control system for guidance before and after thrust termination, has been developed by Chance Vought Aircraft, Inc.

The missile incorporates a cruciform set of low aspect ratio fins attached to the outside of the solid rocket motor case. Gimbaling the entire motor during burning provides thrust vector control during that flight period, while aerodynamic forces on the fins during flight after burnout are sufficient to maintain control to the longest range of the missile, it was revealed at the American Rocket Society semiannual meeting here by the company's R. J. Blalock, Jr., and J. C. McCracken.

System advantages, according to Chance Vought, include use of a fixed-angle launcher. Coupled with the simplicity of a solid propellant engine, field operations become very flexible and reaction time is short.

Missile configuration was based on combat unit direct support mission requirements. Maximum diameter is 12 in., total length 145.5 in., gross weight 530 lb. Maximum design range is 12 mi. and minimum range is 1,000 ft.

Missile is built in two basic units—forward section and rocket motor section. A universal joint connects the rocket motor to the airframe proper, with two hydraulic actuator linkages providing deflection of the entire motor.

One guidance and control system is used for both powered and unpowered flight. Rocket motor deflection provides yaw and pitch control, while the four hydraulically-actuated fins mounted near the midpoint of the missile provide the constant roll attitude which is used to prevent cross-coupling in yaw and pitch axes.

Two displacement, free-type gyros provide attitude reference, one for pitch, the other for yaw and roll. Both are powered by d.c. motors. Two rate gyros, also d.c. motor-driven, provide rate damping in pitch and yaw axes.

Missile range is controlled by a pitch programmer which is set before launch, and causes the missile to dive to the ground at the proper time during flight. Electric control valves on the actuators respond to signals from the guidance system amplifier. All electrical units use power from nickel cadmium cells.

Rocket motor case design and manufacture was performed by Chance Vought, with Astrodyne assisting under contract in propellant grain design, conducting development tests and assembling flight test motors.

Original motor parameters were changed during the program, and flight test motors were used which had an average chamber pressure of 450 psia., a thrust of 1,270 lb. at 70F, and total impulse of 19,600 lb./sec. Motor case used 17-7 PH stainless steel, heat-treated and aged to 160,000 psi. yield.

Argon seam-welded center section is closed at the front by a concave head. Structural weight is sacrificed in this design to get the motor center of gravity a minimum distance from the universal joint. Aft closure is conventionally convex, with nozzle of 30 deg. cone angle and expansion ratio of 5.08. Nozzle internal surfaces are coated with alternate layers of Rockide-A and molybdenum.

Castable Formulation

The propellant is a castable formulation of polyurethene fuel and ammonium perchlorate oxidizer, chosen for its immediate availability rather than for particular properties or characteristics.

A missile flight-test program was established to prove feasibility of the overall concept rather than specific characteristics. Tests were conducted on a Redstone Arsenal range 24,000 ft. long, and movie cameras and radar were only instrumentation used in the six test flights which were made.

Flights were:

- **Missile No. 1**—Aim for midrange distance.
- **Missile No. 2**—Aim for midrange distance.
- **Missile No. 3**—Recalibrate and modify pitch programmer based on results of flights 1 and 2.
- **Missile No. 4**—Aim for midrange distance.
- **Missile No. 5**—Aim for maximum range distance demonstration flight.
- **Missile No. 6**—Aim for short range demonstration flight.

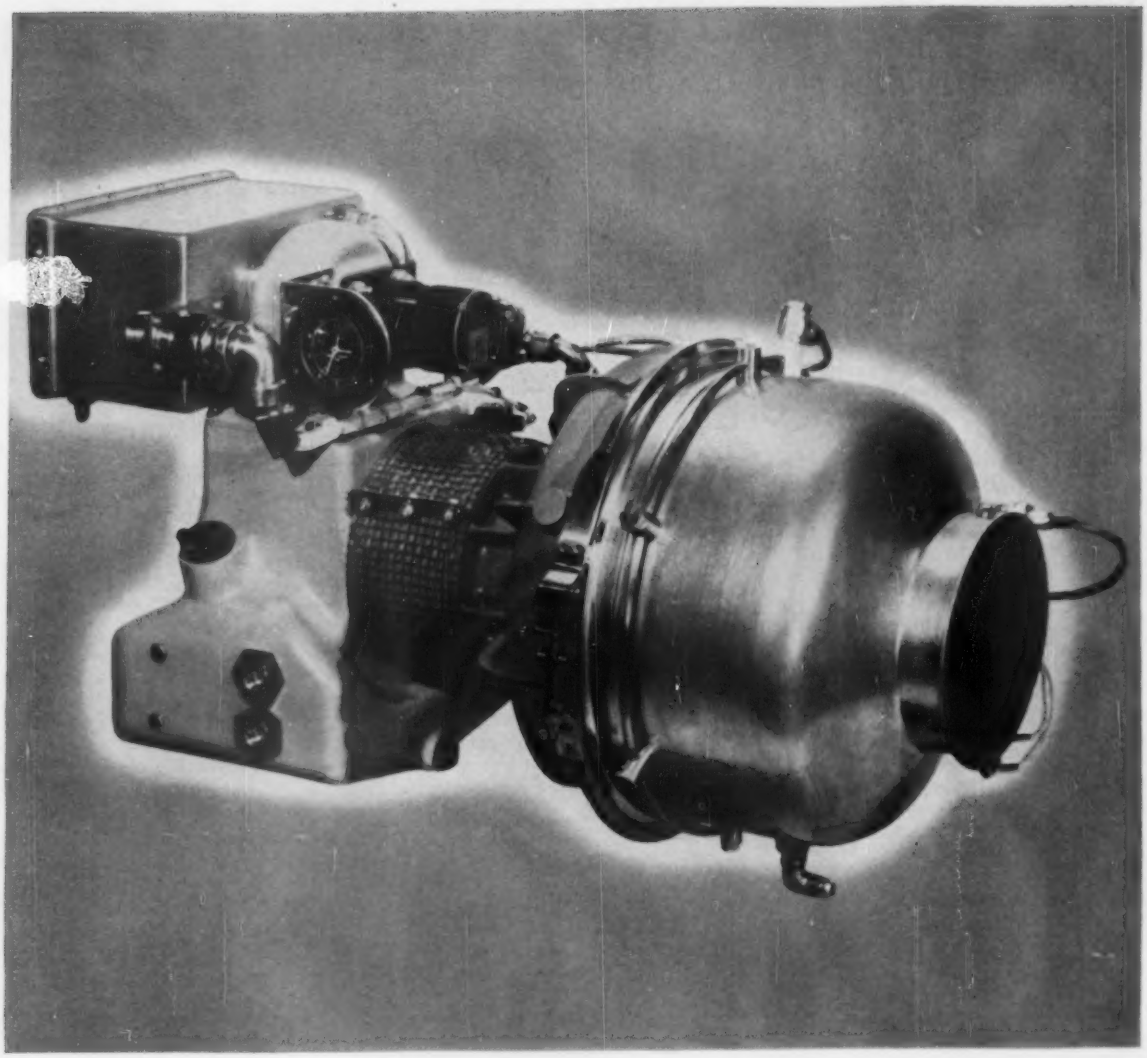
Flight of first missile resulted in satisfactory launch, pitchover and terminal phase, except that a distance of 4,200 ft. was achieved while programmer setting had been based on a desired distance of about 16,300 ft.

The second missile experienced an in-flight malfunction—after launch, a pitchover to the proper trajectory occurred, which was followed immediately by a large upward deflection of the motor. The missile performed a violent loop and was destroyed by command destruct.

Flight missile number three had a modified pitch programmer and was set for a distance of about 15,200 ft.,

Nike Zeus Electronic Devices Housed in Radome

Artist's conception of Nike Zeus anti-missile missile system radome, to be erected on Kwajalein Atoll in South Pacific, shows rubberized Goodyear fabric dome suspended beneath a metal framework. Styrene plastic blocks will be placed between fabric and framework and when completed protective fabric dome and framework will be removed.



Multipurpose APU

New Solar gas turbine 80 hp APU is only 12½ in. in diameter x 25 in.—weighs 59 lb

SOLAR'S NEW gas turbine powered multipurpose APU is ideally suited for airborne and ground power applications—to drive hydraulic, electric or pneumatic outputs for aircraft starters, fuel pumpers and portable generator sets. The *Titan* engine has the highest power-to-weight ratio of any powerplant in its class. It is ideal for single or multiple outputs from 25 hp to 80 hp.

The lightweight unit is simple in design, easy to maintain and can be started instantly—without warmup—in temperatures from —65F to 130F and under wide atmospheric extremes. It operates efficiently on a variety of fuels.

Titan gas turbines are setting new standards of performance and reliability as propulsion units for one-man helicopters, in portable electric generators and in other applications. For details, write to Dept. H-127, Solar Aircraft Company, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY

but impacted at 9,750 ft., with an electronic complication established as the cause.

Flight of the fourth missile was aimed for a distance of 20,900 ft., and the missile impacted 19,700 ft. downrange. Calculations showed a new thrust curve was needed. Based on the revised thrust curve, the flight point passed directly through the curve at the proper point, indicating feasibility of the control system at long range.

Last missile was to be a short flight, pitch programmer calling for impact about 2,720 ft. downrange.

The missile actually impacted 2,790 ft. away.

Relationship of pilot effectiveness over automatic control system in terms of weight and cost in the X-15 program was outlined by James Drake of North American Aviation's Los Angeles Division.

Plots were made of the over-all efficiency of both types of control, Drake said, with the rocket ship's controls and displays designed for maximum help to the pilot, rather than as auxiliary aids to his senses.

Pilot was considered in two terms, his presence, per se and the lack of equipment (which his presence displaced). His presence served as a servomechanism, programmer, and computer and the equipment lack increased the over-all system reliability and decreased the weight. Functioning in the programmer role, pilots were able to recognize the whole problem and, when competing with a computer in a simulated autopilot system for solution, were well ahead.

A simulator was set up wherein pilots flew the mission profile in six degrees of freedom, wherein profile called for a 4g pullup after launch, a zero g climb to 250,000 ft., and a pullout at the maximum lift coefficient. Following pilot demonstration of ability to fly the mission while staying within the line width of the mission profile chart, the weight analysis of autopilot equipment to match this performance showed even more advantages for human piloting.

Average weight of the pilot and his equipment was established at 700 lb. He operates some 20 controls and utilizes some 60 indicators for making his decisions.

Taking a weight average of one-half pound per unit and interconnecting each of the indications and controls showed some 7,200 components were required to fill the job, and the weight saving proved significant, Drake said.

Backing the decision, he declared, is the record established by the X-15 in the first eight flights—a maximum altitude of 80,000 ft. had been reached and speed of Mach 2.5, and in all cases, the hardware was reusable, an unusual condition in missile testing.

Rocketdyne Studies Lightweight Rocket Plug Nozzle Configuration

Los Angeles—Nozzle thrust chamber configuration for conventional chemical propellant engines which inherently tends to yield very high efficiencies from the ground to extreme altitudes was described at the semiannual meeting of the American Rocket Society here.

Other development efforts reported on which promise worthwhile advances in booster and upper stage propulsion systems were:

- **Pulsed plasma pinch engine** which has been run continuously for 118 hr. at 0.01 lb. of thrust with 195F the maximum operating temperature. Efficiency was about 25%.
- **Hybrid solid-liquid rocket** engine which can be throttled over 100% of its thrust range, stopped and started at will.

Use of a plug shaped like a mushroom, with the stem extending from the injector face outward, and the button placed just aft of the throat, provides a shorter nozzle skirt for high expansion ratio engines, among other advantages, according to G. V. R. Rao of Rocketdyne Division, North American Aviation.

The configuration is somewhat similar to the plug nozzle approach but without the weight of the large annular combustion chamber or the criticality of the nozzle exit, plug shape and dimensions, Rao said.

A comparison, according to Rao, with the weight of a conventional bell nozzle taken as 100, would show the plug nozzle to be about 150. Since the new shape is about one-third lighter than the plug, it would have the same 100 value as the bell nozzle.

The new configuration is termed an "expansion-deflection" (E-D) nozzle, and both cold flow tests and hot firings of a chamber of "significant thrust" level have been accomplished, Rao said. In the hot firing, 1,000 psi. chamber pressure was used, and the area ratio was 42.

Design features of the E-D nozzle, Rao said, include fabrication of the plug with nickel regenerative cooling tubes as are used in today's bell nozzles, as well as regenerative cooling for the skirt.

Under study for the E-D nozzle are possibilities of thrust vector control by tilting the mushroom button, and thrust modulation by fore-and-aft movement of the whole plug. Preliminary analysis shows that combustion stability is good with the plug extending through the burning portion of the thrust chamber, and axial movement of the plug will not significantly affect the combustion stability, since chamber pressure remains the same.

Since exhaust gases are deflected by the plug button, ambient atmospheric pressure can exist in the core of the exhaust, and this pressure automatically shapes the exhaust and its cross section to obtain very high efficiency at low as well as high altitudes, Rao indicated.

Shortness of the nozzle allows reduced interstage structure if the E-D nozzle is used on upper stages of multistage vehicles, Rao said, allowing structural weight reduction in the total vehicle. The pulsed plasma pinch engine was developed at the Plasma Propulsion Laboratory of Republic Aviation Corp. Details were revealed by A. E. Kunen, I. Granet, W. J. Guman and William McIlroy.

The pulsed plasma technique is not new, but the Republic work showed that proper electrode shape and relationship of current and gas produce good efficiency over long operating periods.

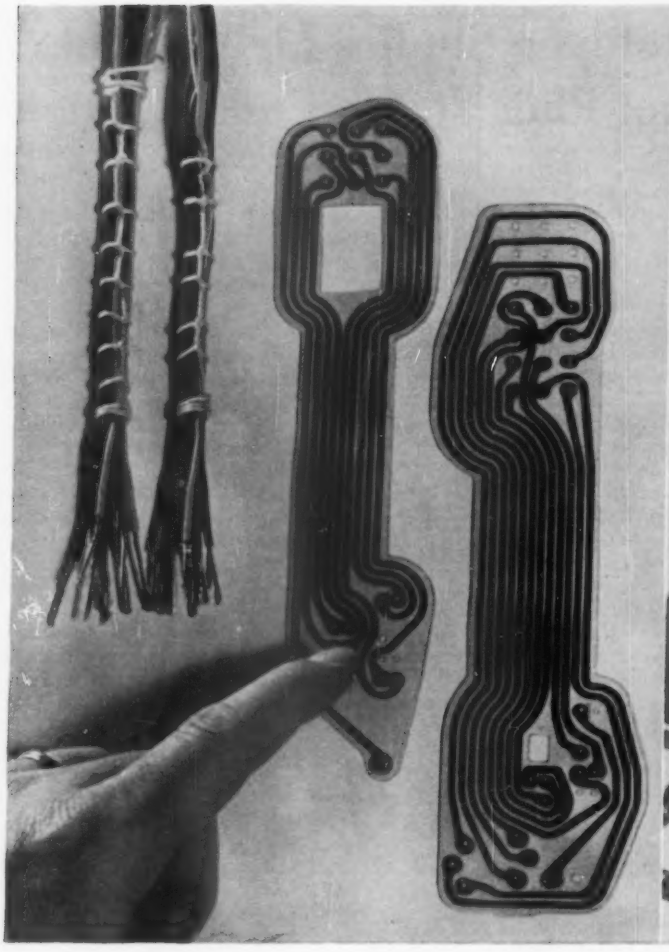
Gaseous nitrogen working fluid, two pinches/second operating cycle, at 300 Joules current in a high vacuum chamber environment were used in the tests. Gas entered a plenum chamber prior to entry into the electrode area. As gas density reached the level where it became conductive in the electrode area, current was released from the condenser bank, the gas was "pinched," flowed out the nozzle and new gas flowed in to reactivate the cycle.

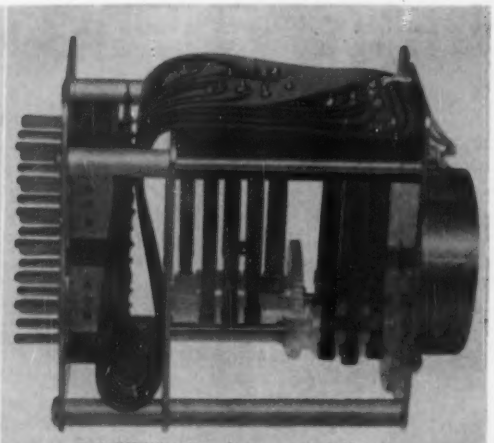
Grand Central Rocket Co. has run a 1,000-lb.-thrust hybrid (liquid-solid) engine with complete throttling control over the entire thrust range, has started and stopped the engine at will, and has allowed periods of several days between relighting the engine, according to Grand Central's John Gustavson.

The hybrid engine uses aluminized rubber as fuel, chlorine trifluoride as oxidizer. Combustion chamber is packed with fuel only. Liquid oxidizer is injected, and the hypergolic mixture ignites along the core surface of the fuel. Combustion stabilizes and remains stabilized, Gustavson said, despite the constantly increasing burning surface area, which goes through a 1 to 2 change.

The system has a self-controlling mixture ratio with a constant oxidizer flow rate, which approximated 1.5 lb./sec. at full 1,000 lb. thrust. Chamber pressure was 300 psi.

The combustion chamber has to be sufficiently long to ensure complete combustion of the oxidizer under present conditions. Geometry of the fuel burning surface is critical.





A. W. Haydon interrupter timer

Western Electric Call Director telephone

Correct wiring connections made twice as fast!

2 Flexprint® Cables replace 22 wires in A.W.Haydon's interrupter timer...

in one of Western Electric's convenient unattended office telephone systems — utilized by both the familiar push-button control telephones and the exciting new Call Director telephones (shown). The multi-function interrupter timer performs 12 automatic switching functions within the Western Electric system.

The A. W. Haydon Co., Waterbury, Conn. switched from conventional wiring to FLEXPRINT cables to speed up accurate location of connections and simplify soldering of 44 terminals. Result: *wiring time cut in half.*

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Ling-Temco Merger Appears Assured

Dallas, Tex.—Stockholder approval of a merger of Ling-Altec Electronics, Inc., and Temco Aircraft Corp., is probable June 30 when shareowners of both corporations vote on the proposition, top officials of the companies indicated here last week.

Ling-Altec board chairman and chief executive James J. Ling and Temco president Robert McCulloch noted that they already have received favorable reaction to the merger plan from major shareholders.

There had been some unrest among Ling-Altec major shareholders over the initially proposed executive management lineup, under which James Ling was to be vice chairman of the board and chairman of the executive committee and Temco executive vice president-general manager Clyde Skeen designated as president of the new corporation.

These differences apparently have been resolved by designating Ling president and chairman of the executive committee and Skeen the executive vice president-general manager. Ling-Altec executive vice president-secretary-treasurer Lee D. Webster, who had been proposed as Ling-Temco executive vice president, would be designated vice president-secretary-treasurer of the new firm.

Also altered was the stock exchange basis, originally one share of Ling-Temco for one share of Ling and six tenths of a share of Ling-Temco for one share of Temco. Now Temco shareholders will receive 48/100 of a share of common and 12/100 of a share of a special convertible preferred stock for each share of Temco.

Investment banking firms with large Ling holdings were instrumental in the changes, but now are reported to be supporting the merger. Temco president McCulloch, who had initially been proposed as board chairman of Ling-Temco electronics, retains his title.

Lineup of board of directors having voting privileges, to be proposed to stockholders, provides for a 12-man panel, with six members from each company. From Ling-Altec are James J. Ling, Lee D. Webster, Dr. V. A. Davidson, Paul Hallingby, Jr., Alvis A. Ward and James O. Weldon. From Temco are McCulloch, Skeen, D. H. Byrd, James Cumby, Harold Volk, and O. Ray Moore.

Advisory, non-voting directors proposed are D. C. Hickson, R. C. Lewis, Cameron J. Pierce, Frank D. Rose and O. G. Villard, Jr., of Ling-Altec and H. N. Mallon and H. L. Howard of Temco.

Under the merger, Temco Aircraft would be renamed Temco Electronics & Missiles Co., having four divisions—Missiles and Aircraft, Overhaul and Servosystems, Electronics and Industrial. Also under the new lineup, which would be headed by Ling-Temco Electronics, Inc., would be the principal Ling operating companies—Continental Electronics Manufacturing Co., Dallas; Electron Corp., Dallas; Ling Electronics Division, Anaheim, Calif.; Ling-Altec Research Division, Anaheim; Altec Lansing Corp., Anaheim; Peerless Electrical Products Division, Los Angeles; Calidyne Co., Inc., Winchester, Mass.; United Electronics Co., Newark, N. J., and Universal Loudspeakers, Inc., White Plains, N. Y.

Ling-Temco program will be aimed at building the strongest and largest possible vertical electronics organization, with considerable concentration on space communications, which James Ling feels is just in its embryo and offers considerable market potential. Ling feels that research now being done at Lincoln Laboratory, Bedford, Mass., on super-high power transmitting equipment opens a new area of product potentials for the electronics industry. Ling-Altec already has developed some equipment in this field, such as super-power transmitters for Voice of America and Navy's long-range moon-relay communications system. They are also being used in studies involving bouncing radar signals off Venus.

At the time of the merger, the new company is expected to place just behind Litton Industries in business volume, Ling noted, although long-range plans are to develop Ling-Temco to a top stature in electronics. Litton's sales volume for the first nine months of the year ending Apr. 30 totaled $134,459,000. Net earnings were $5,411,000.

Feeling is that the combination of Ling-Altec and Temco Electronics research, development and production will make possible a major step in building growth of both operations, since the combination will provide crossfeed of talent and other capabilities, making possible integration of present products into systems more readily marketable than possible individually. One instance noted, for example, is Temco's potential in displays and Ling-Altec's experience with super-power radar and communications, which would provide the basis for systems required in future space operations.

Combination will also develop a strong research and manufacturing team more capable of handling large projects as either a systems manager or as a team member in a joint venture. Further acquisitions of electronics potential apparently will be made to fill in any gaps in the organization.

Ling and Temco feel that the merger will provide the new company with at least two years jump in capability over what either firm could have achieved working by itself, and the increased potential and working capital will also make possible a faster rate of growth than either could achieve separately. It was indicated that Temco is coming into the new organization with some $40 million in yet-unannounced electronics research and development business that will benefit greatly under the merger. Indications are that the merger will also provide Ling-Altec with considerable Temco production capability that it will find useful.

Vickers 1959 Sales, Earnings Show Drop

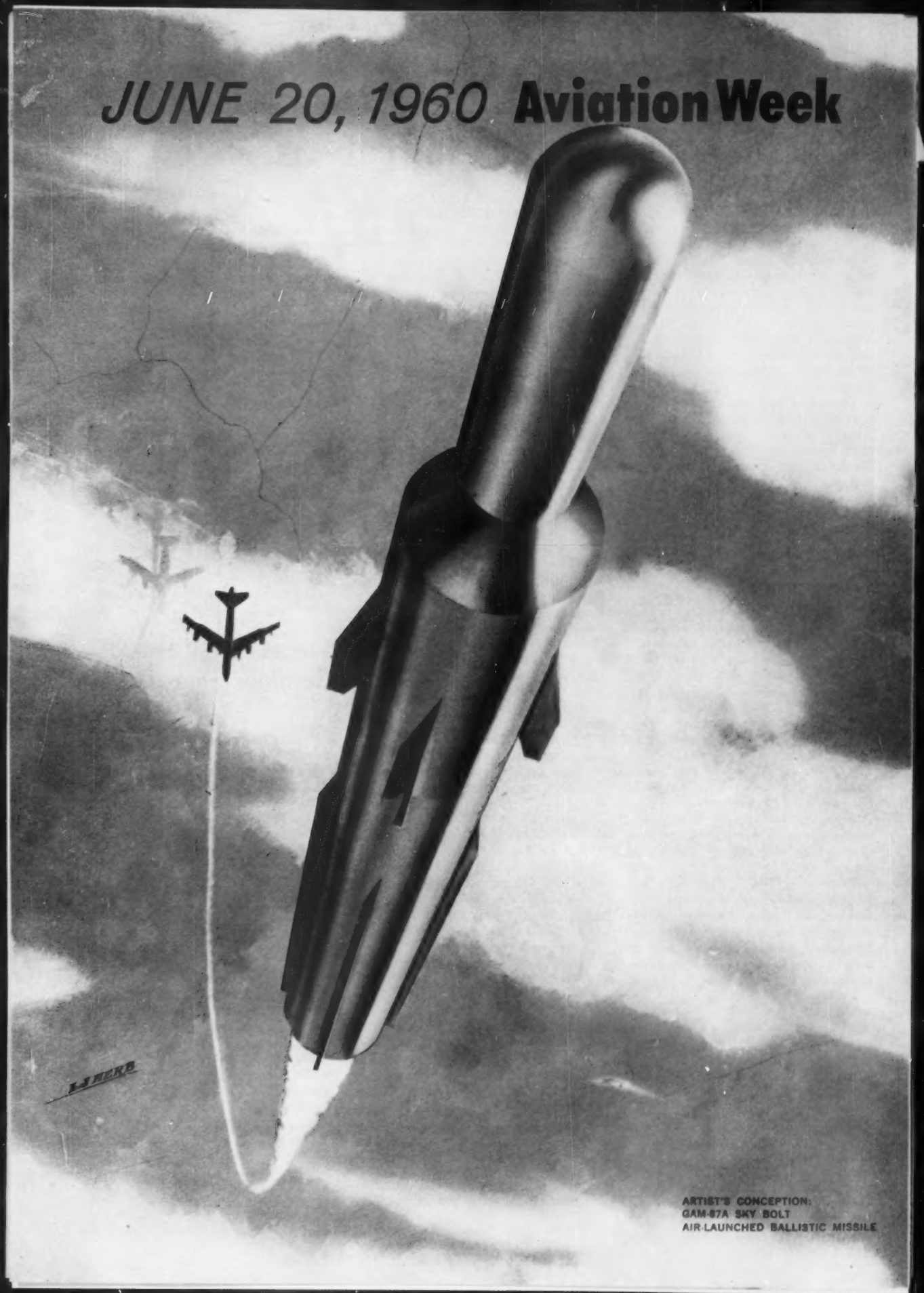
London—Annual report of Vickers, Ltd., for 1959 shows lower turnover, a depleted order book and smaller profits than the previous year. The Aircraft Division—now parent of the British Aircraft Corp., Ltd., one of the two main airframe groups—was mainly responsible for the fall in both sales and new orders.

Group sales fell by $61.6 million to $434 million, of which aircraft provided only $115 million against the 1958 figure of $182 million. Total orders on hand at year-end stood at $790 million compared with a 1958 figure of $874 million, and group profits before taxation were $25.2 million, $10.4 million less than in 1958.

Points from the report:

- **Work on the TSR2** tactical strike-reconnaissance aircraft has now reached the detail design stage. It is expected to be "of considerable interest to Commonwealth air forces."
- **Ministry of Supply** contract for a design study of variable geometry aircraft on the lines of the Barnes Wallis Swallow is a "half-cost contract." First phase of this work is nearly done, but "there are a number of studies still to be completed before it is possible to assess whether the application of variable geometry would be advantageous."

JUNE 20, 1960 Aviation Week



ARTIST'S CONCEPTION:
GAM-87A SKY BOLT
AIR-LAUNCHED BALLISTIC MISSILE

SAC IN TRANSITION

A Special Aviation Week Report on the Strategic Air Command's Transition into the Aerospace Age

The changing role of the Strategic Air Command in the national defense picture will be featured on June 20th in a special 36-page report prepared by AVIATION WEEK editors with on-the-spot coverage of the SAC Command—The nation's shield against aggression.

This exclusive report will be published in answer to the growing requirement for an improved national understanding of SAC's changing role as the primary deterrent force guarding national security. The annual R&D issue will be devoted to this message which is today's most challenging subject.

The Strategic Air Command's deterrent position has undergone complex and fundamental changes in its transition to a Strategic Aero-Space Command—with its formidable bomber fleet soon to be reinforced by intercontinental ballistic missiles operationally deployed to instantly counter any aggressive action.

The transition of SAC is one of the most rapid and exciting events in the history of our nation and its defense. What SAC needs, what lies ahead and the weapon systems to be employed in the immediate future will be key subjects included in this first-time technical evaluation. The impact of new technologies and weapon systems has changed the entire defense concept and the response of SAC to these new requirements has been effective and positive.

AVIATION WEEK editorial teams are now engaged in the compilation of the new SAC story—one that will generate world-wide readership. This issue, "SAC In Transition," offers manufacturers and suppliers of the aerospace industry an unusual opportunity to advertise and identify their role in the national defense effort.

Aviation Week and **Space Technology**

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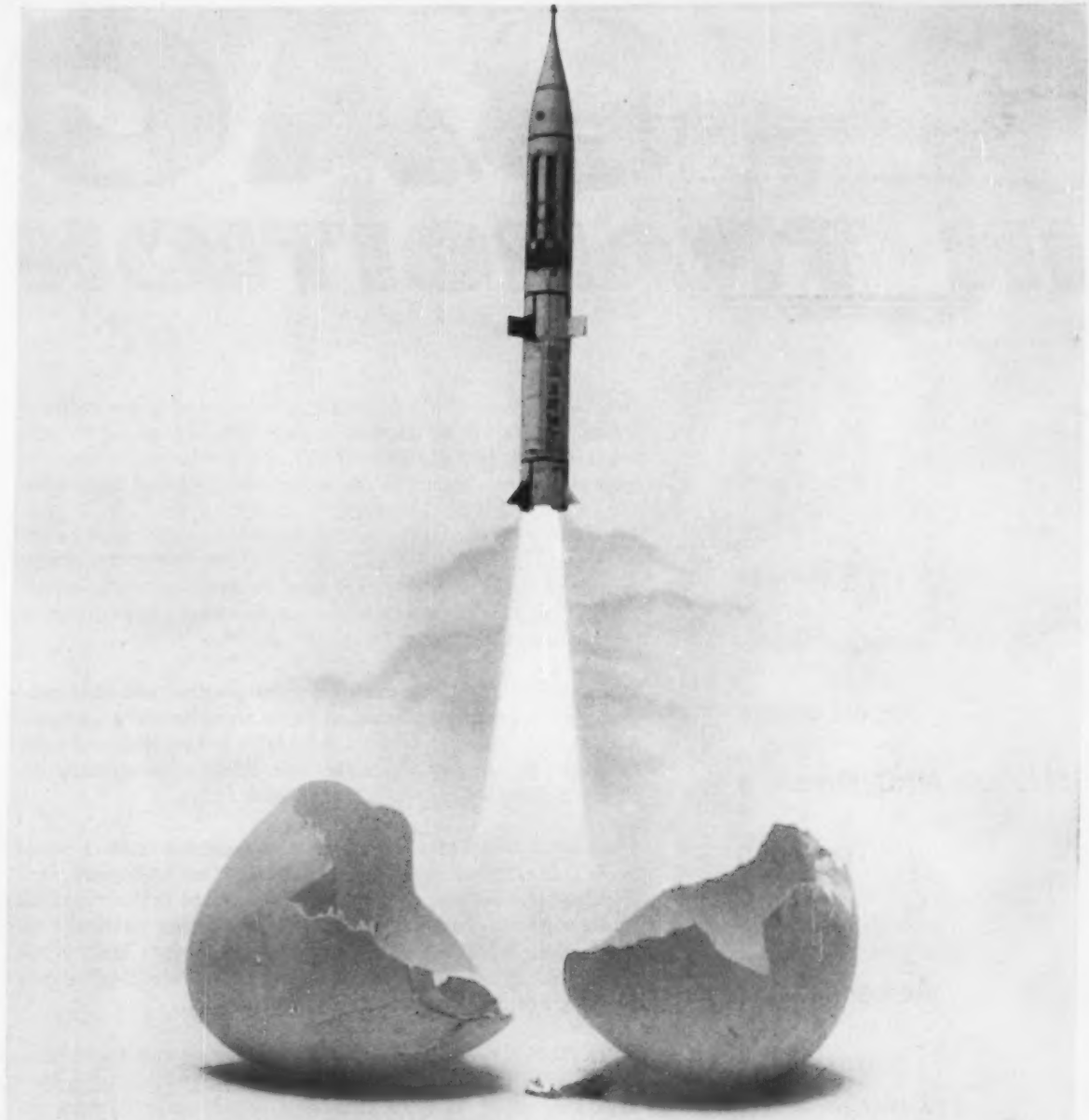

they hatched this bird in record time where the sun shines all year long

Less than two years after the Army contract was announced, Martin's Pershing missile roared off its pad to pass its first flight test. The project was right on schedule.

This exciting new "shoot-and-scoot" solid propelled weapon can move up on its own all-terrain carrier or by airplane. It destroys major targets over a wide selective range.

Advanced Weapons Systems like Pershing are developed in Martin-Orlando's climate of achievement. It's a "climate" that nurtures imagination, curiosity and determination —qualities that turn out missiles like Bullpup and Lacrosse, and electronic achievements like the Missile Master air defense control system.

Combine 12-month-a-year sunshine living in Florida with career success. Join an organization that has continuously led the way in the development and production of major missiles and electronic systems. Write to C. H. Lang, Director of Employment, The Martin Company, Orlando 9, Florida.

CURRENT OPENINGS for engineers in these areas: ground and airborne electronics • advance design • systems • aerodynamics • quality and test • reliability • electronics manufacturing . . .

WORK IN THE CLIMATE OF ACHIEVEMENT

MARTIN
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New Offerings

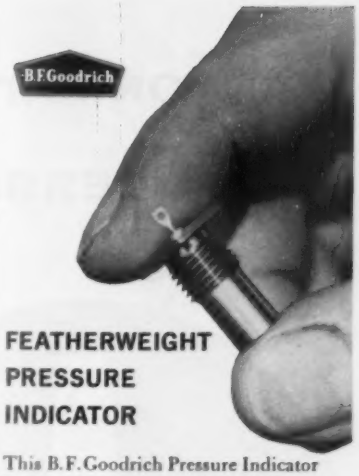
Harnischfeger Corp., Milwaukee, Wis., engaged primarily in the manufacture and sale of a diversified line of heavy machinery and equipment. Offering is 60,000 shares of convertible preferred stock, $100 par, for public sale; dividend rate, offering price and underwriting terms to be supplied by amendment. Proceeds will be applied to the repayment of a portion of the company's short-term bank borrowings. A previous offering last year was withdrawn because of unfavorable market action.

The Garrett Corp., Los Angeles, Calif., engaged primarily in research, development, engineering and manufacturing of specialized parts, components, and systems for aircraft and missiles, together with related ground support equipment. Offering is 100,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds, together with $12,000,000 to be borrowed from insurance companies under a long term loan agreement, will be used to pay indebtedness consisting of $13,500,000 of short term notes; $2,321,429 of long term notes; a $306,250 long term note issued in connection with the acquisition of certain subleases.

Stelma, Inc., Stamford, Conn., organized under Delaware law in March, 1960, for the purpose of acquiring 100% of the outstanding stock of Stelma, Inc., a Connecticut corporation, organized in April, 1951, by the present principal stockholders of the Delaware company, to develop and manufacture telecommunications equipment for commercial and military systems and test applications. At present, work is evenly divided between engineering and production operations; products include pocket size analyzers and computer type equipment necessary for high speed data transmission systems. Offering is 175,000 outstanding shares of common stock for public sale by the holders thereof. Offering will be made on a best efforts, all or none basis.

Arco Electronics, Inc., New York, N. Y., organized under Delaware law in February, 1960, as successor to a New York corporation of the same name which commenced business in 1945. The company and its subsidiaries are engaged in the manufacture and sale of capacitors and related products. Offering is 140,000 shares of Class A common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $50,000 will be used for expansion of the company's advertising and merchandising activities; $30,000 for research and development; $120,000 for expansion and improvement of the company's physical plants and equipment; $150,000 to carry additional inventories for production and additions to its product lines; the balance for working capital.

Edgerton, Germeshausen & Grier, Inc., Boston, Mass., engaged in the design, production and application of electronic and nucleonic instrumentation systems as a prime contractor to the Atomic Energy Commission and the company also has participated in other scientific research and development projects in electronics for other agencies and private industry; it has developed and is expanding its own line of commercial products and components, specializing in the design and production of instruments and components for the control and measurement of ultra high speed phenomena. Offering is 120,000 shares of common stock; 100,000 shares to be offered by the company and 20,000 outstanding shares by the holders thereof; public offering price and underwriting terms to be supplied by amendment. Of the proceeds, $500,000 will be used in connection with the purchase of new or additional equipment and the replacement of certain items of equipment now furnished



FEATHERWEIGHT PRESSURE INDICATOR

This B.F.Goodrich Pressure Indicator incorporates an Omega-design bellows, which closes a contact when pressure reaches a preset value in the range of 250 to 500 p.s.i. Device is less than 1 inch long, weighs under half an ounce. Now used in primary missile batteries and torpedo batteries; special design can be built to meet your needs. Write for complete information.

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aviation products
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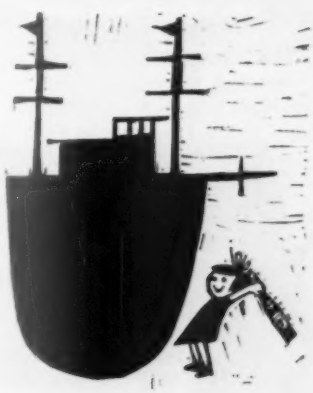
PROBLEMATICAL RECREATIONS 17

Mary Ann Moore's father has a yacht and so has each of his four friends: Colonel Downing, Mr. Hall, Sir Barnacle Hood, and Dr. Parker. Each of the five also has one daughter and each has named his yacht after a daughter of one of the others. Sir Barnacle's yacht is the Gabrielle, Mr. Moore owns the Lorna; Mr. Hall the Rosalind. The Melissa, owned by Colonel Downing, is named after Sir Barnacle's daughter. Gabrielle's father owns the yacht which is named after Dr. Parker's daughter. Who is Lorna's father?



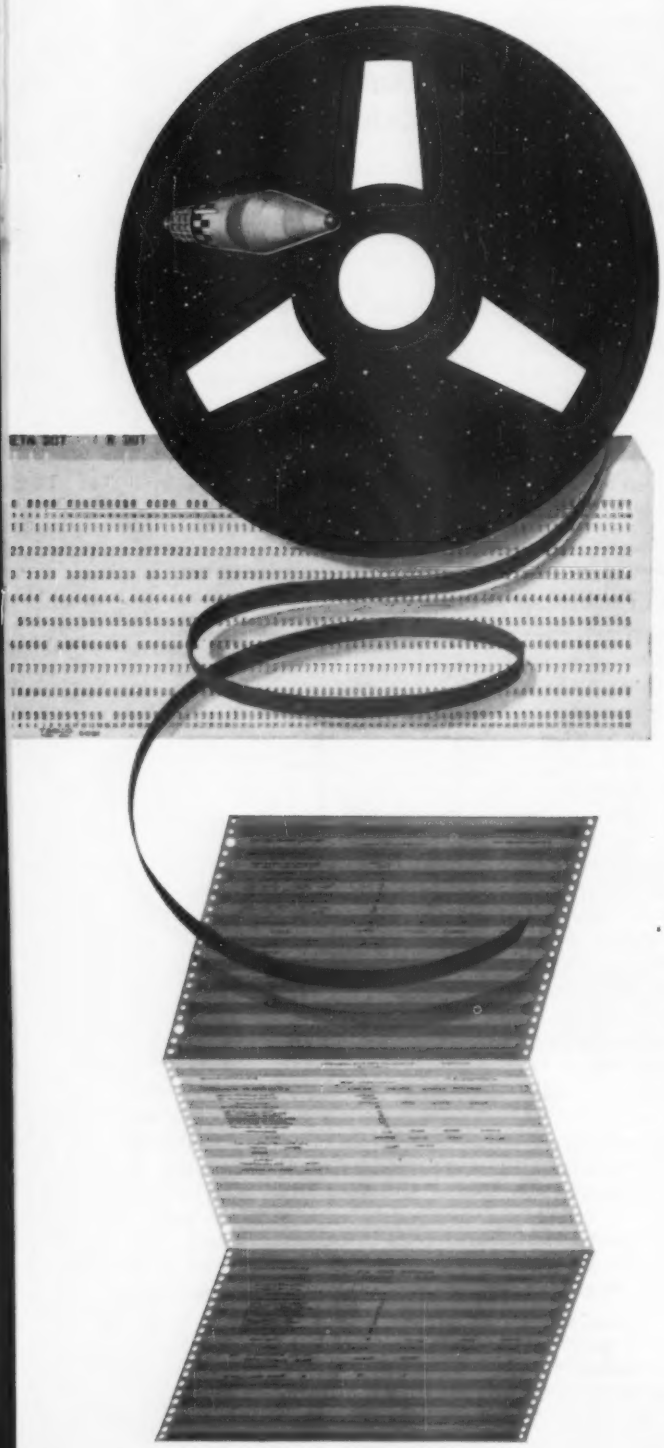
—Kansas State Engineer

Inquiries concerning non-linear function pots, load compensated pots, and pots with special mechanical configurations should go to our Potentiometer Division, Mt. Vernon, New York. Saves time.

ANSWER TO LAST WEEK'S PROBLEM: One cut in the third link will allow two links to be swapped for a kiss and a link on the second transaction, and 3 links for a kiss and 2 links on the third and so on.

LITTON INDUSTRIES
Beverly Hills, California

INFORMATION PROCESSING



Information Processing plays a vital role in the Lockheed Missiles and Space Division's activities—from aiding basic research and development to supporting current military and commercial projects. The Division's computing facilities are among the most advanced in the country and include: two—IBM 7090; two—Sperry-Rand 1103 AF; one—Control Data Corp. 1604, in addition to a variety of other advanced peripheral equipment. Future plans include several IBM 1401 Data Processors.

Functions of Information Processing encompass: Preparing programs and operating large, high-speed digital computers; responsibility for the Division's analog computing activities—including set-up and operation of analog computers, used both as simulators and in solving problems; the reduction of highly complex and critical telemetry data received from missiles and space vehicles.

Further activities involve performing data reduction for Quality Assurance and Manufacturing, and programming of Administrative Data Processing and Financial Forecasting Problems for the entire Division.

Expanding the scope and depth of present programs in Information Processing has created positions for engineers and scientists with experience in these important areas:

DIGITAL COMPUTER SYSTEMS DEVELOPMENT including monitors, compilers and information retrieval systems.

HIGH-SPEED DIGITAL COMPUTER PROGRAMMING for satellite control, scientific computation, numerical analysis, and administrative data processing.

TRAINING PROGRAMS conducted for computer programmers and operators.

ANALOG COMPUTER OPERATION in solving complicated engineering problems.

AUTOMATIC CONVERSION of flight data and scientific information utilizing analog and digital converters and advanced automatic control devices.

FLIGHT DATA AND SYSTEMS ANALYSIS including research in complex problems, theories and methods of preflight and flight data analysis; test performance research; analysis and performance reports on testing, flight test data and data reduction.

DATA PROCESSING EQUIPMENT DESIGN including research and engineering in development of highly advanced data conversion devices.

Engineers and Scientists: Work in the broad spectrum of Information Processing functions provides constant challenge at Lockheed's Missiles and Space Division. If you are experienced in the above areas, you are invited to write: Research and Development Staff, Dept. F-17A, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

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MISSILES AND SPACE DIVISION

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by the government; $200,000 will be used to increase inventories; the balance will be added to the company's general funds and used to meet design, development and other costs in connection with the introduction of new products and the expansion of present product lines and for other corporate purposes.

McCormick Selph Associates, Inc., Hollister, Calif., engaged in research and development work and the manufacture and sale of various products in the field of explosive ordnance. Offering is 130,000 shares of capital stock: 100,000 shares to be offered for public sale by the issuing company, and 30,000 outstanding shares by the holders thereof. Offering price and underwriting terms to be supplied by amendment. Of the proceeds, $195,000 will be used to retire existing indebtedness to a bank; $80,000 to reduce suppliers' accounts payable; balance will be added to general funds and will be used primarily to carry larger inventories and trade receivables.

Laboratory for Electronics, Inc., Boston, Mass., engaged in research, development and production of electronic equipment for aviation and other military uses. Offering is 100,000 shares of common stock, to be offered initially to company stockholders; offering price, subscription rate, record date and underwriting terms to be supplied by amendment. The company estimates that it needs $2,000,000 of new working capital to finance the conduct of its business at the present rate, and to finance expansion; any proceeds not needed for such purposes will be used to reduce bank loans.

Itemco, Inc., Port Washington, N. Y., engaged in the manufacture of environmental test equipment which reproduces the temperature, humidity and pressure extremes found on or near the earth's surface, in the stratosphere, and in the space beyond. Offering is 200,000 shares of common stock for public sale at $2.50 per share; the underwriters have made a firm commitment to purchase 60,000 shares, and 140,000 shares are to be offered on a best efforts "all or nothing" basis. Of the proceeds, $60,000 will be used for the repayment of certain current indebtedness including trade payables, and $50,000 for repayment of certain current indebtedness guaranteed by company officials and stockholders. If the 140,000 shares are sold, the proceeds will be used for instrumentation and automation of laboratory equipment; expansion of existing manufacturing facilities and the acquisition or establishment of additional facilities; repayment of certain indebtedness owned to or guaranteed by certain directors and stockholders; the balance for working capital.

Acquisitions And Mergers

Avien, Inc., of Woodside, N. Y., purchased Colvin Laboratories, Inc., and Pressure Elements, Inc., both of East Orange, N. J., for 30,000 shares of Avien Class A capital stock. Colvin produces electromechanical instrumentation; Pressure Elements makes pressure capsules for transducers. Avien designs and makes instrumentation for temperature control, fluid flow measurement, automatic checkout and undersea systems.

Technology Instrument Corp. of Acton, Mass., has acquired the electromagnetic clutch and brake product line of Haddam Manufacturing Co. Operations of Haddam will be consolidated with TIC's work in making modular servo components.

Telecomputing Corp., Los Angeles, has purchased for an undisclosed cash amount the previously unacquired 13% of Frank R. Cook Co., Telecomputing's Denver subsidiary which designs, develops and manufactures high-energy silver-zinc batteries for auxiliary power sources in missiles.

Dynex, Inc., Syosset, N. Y., purchased Matronics, Inc., computer manufacturer. Dynex produces computer components.

Controls Co. of America's subsidiary Solid State Electronic Controls, Inc., Tempe, Ariz., has been merged with the parent company and will become the Electron Division, continuing to develop and manufacture semiconductor devices aimed primarily at instrument and controls applications.

Raytheon Co. has agreed to purchase Garlynn Engineering Co., San Francisco, and will operate the acquisition as a facility of Raytheon's Marine Products Operations. Garlynn manufactures electronic, electromechanical and instrumentation devices.

Chandler Evans Corp., producer of fuel control systems and accessories for aircraft and missiles, has purchased major assets of Farmingdale Manufacturing Corp., Farmingdale, L. I., a research and development firm specializing in hydraulics, pneumatics and electronics.

Kollmorgen Optical Corp., Northampton, Mass., and Inland Motor Corp., manufacturer of torque motors for missile production, have merged through an exchange of stock.

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Versatile, practical-minded engineers with a record of accomplishment in the missile, aircraft or related fields will now qualify for a flight test position at Convair/Astronautics – creators and testers of the mighty Atlas ICBM. Positions must be filled immediately at various locations from Cape Canaveral, Florida, to Vandenberg AFB near Santa Maria, California. Openings exist in: Propulsion • Hydraulics • Pneumatics • Propellant Transfer Systems • Missile Structures • Autopilot and Guidance • Launch Control Systems • Electrical Power • R.F. Systems • Telemetering • Landlines • Ground Support Equipment • Closed Loop TV Systems • Data Analysis.

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CONVAIR/ASTRONAUTICS
CONVAIR DIVISION OF
GENERAL DYNAMICS

Industry Officials' Compensation Listed With SEC for Last Year

Washington—Following is a list of aerospace industry officers' and directors' salaries, bonuses and stock holdings for 1959 as filed with the Securities and Exchange Commission:

Fairchild Engine & Airplane Corp.—**J. H. Carmichael**, president and director, $77,000 salary and 100 shares of stock; **W. L. Landers**, vice president, $69,964 salary and stock not listed; **F. E. Newbold, Jr.**, vice president and director, $64,995 salary and 110 shares of common stock.

Following directors were not paid a salary: **J. A. Allis**, 2,600 shares of common stock; **R. B. Carney**, 105 shares of common stock; **C. H. Colvin**, 263 shares of common stock; **C. L. De Orsey**, 35,000 shares of common stock; **S. M. Fairchild**, chairman of the board, 100,559 shares of common stock; **W. P. Lane, Jr.**, 4,000 shares of common stock; **G. Loening**, 3,000 shares of common stock; **F. R. Nichols**, 3,230 shares of common stock; **R. S. Stillman**, 100 shares of common stock.

Hiller Aircraft Corp.—**S. Hiller, Jr.**, president and director, $31,999.92 salary and 100,000 shares of common stock; **W. A. Blees**, sales manager of the Adhesive Engineering Division and director, salary not listed, 50 shares of common stock; **E. T. Bolton**, executive vice president, general manager and director, salary not listed, 200 shares of common stock; **A. J. M. Chadwick**, senior vice president and director, salary not listed, 100 shares of common stock, 900 shares of common stock in trust and 106 shares of common stock owned by Mrs. Chadwick; **K. Ferguson**, secretary and director, salary not listed, 1,369 shares of common stock; **F. A. Heileman**, director-advanced research and director, salary not listed, 346 shares of common stock. **A. W. B. Vincent**, vice president and director, salary not listed, 13,302 shares of common stock.

Following directors were not paid a salary: **F. A. Callery**, 100 shares of common stock; **P. M. Hamilton**, 100 shares of common stock; **S. Hiller, Sr.**, 6,008 shares of common stock and 100 shares of common stock owned by Mrs. Hiller, Sr.; **M. E. McAlpin**, 1,259 shares of common stock, beneficial trustee of trust holding 11,716 shares of common stock, nonbeneficial trustee of trust holding 11,395 shares of common stock and 126 shares of common stock owned by Mrs. McAlpin; **H. L. McIntyre**, no stock; **L. B. Richardson**, 186 shares of common stock.

Lockheed Aircraft Corp.—**R. E. Gross**, chairman of the board and chief executive officer, $128,350 salary and 143,572 shares of common stock; **C. S. Gross**, president and director, $101,923 salary and 28,582 shares of common stock; **C. A. Baker, Jr.**, consultant to the corporation and director, $40,489 salary, and 2,060 shares of common stock; **D. E. Browne**, vice president-finance and director, $66,250 salary and 7,154 shares of common stock; **C. Chappellet**, senior vice president and director, $80,201 salary and 23,108 shares of common stock; **D. J. Haughton**, executive vice president and director, $86,635 salary and 6,342 shares of common stock; **H. L. Hibbard**, senior vice president and director, $80,201 salary and 1,994 shares of common stock.

Following directors were not paid a salary: **G. Brashears**, no stock; **J. V. Carmichael**, no stock; **E. S. Dulin**, 500 shares of common stock; **H. L. Dunn**, 500 shares of common stock; **H. Hoover, Jr.**, 2,000 shares of common stock; **W. W. Keith**, 1,200 shares of common stock; **H. W. McCurdy**, 21,856 shares of common stock; **C. B. Squier**, 5,000 shares of common stock.

Minneapolis-Honeywell Regulator Co.—**H. W. Sweatt**, chairman of the board, $125,000 salary and 83,635 shares of common stock; **P. B. Wishart**, president and director, $135,000 salary and 6,260 shares of common stock; **T. McDonald**, executive vice president and director, $90,000 salary and 5,000 shares of common stock; **A. M. Wilson**, executive vice president and director, $90,000 salary and 5,036 shares of common stock; **J. H. Binger**, vice president and director, $54,500 salary and 9,228 shares of common stock; **S. F. Keating**, vice president and director, $50,833 salary and 1,670 shares of common stock; **C. C. Buckland**, vice president, secretary and director, $35,500 salary and 2,137 shares of common stock.

Following directors were not paid a salary: **C. B. Sweat**, 66,160 shares of common stock; **W. L. Huff**, 15,200 shares of common stock; **C. J. C. Quinn**, 400 shares of common stock; **R. P. Brown**, 62,097 shares of common stock; **J. J. Wilson**, 39,410 shares of common stock; **D. C. Swatland**, 100 shares of common stock; **F. Maytag II**, 100 shares of common stock; **P. S. Gerot**, 200 shares of common stock.

The Martin Co.—**G. M. Bunker**, chairman of the board and chief executive officer, $150,000 salary and 72,740 shares of common stock; **W. B. Bergen**, president and director, $95,000 salary and 8,749 shares of common stock. **C. W. Miles**, general counsel and director, $80,000 salary and no stock; **G. T. Willey**, vice president, $52,916 salary and no stock listed.

Following directors were not paid a salary: **H. Bruce**, 4,966 shares of common stock; **W. A. Burns, Jr.**, 210 shares of common stock; **J. E. Parker**, 2,100 shares of common stock; **E. H. Pixley**, 128 shares of common stock; **A. B. Royce**, 254 shares of common stock; **F. F. Russell**, 32,550 shares of common stock owned by the National Aviation Co., of which Russell is a director and chairman of the executive committee; **D. M. Spencer**, 439 shares of common stock; **J. L. Sullivan**, 10,202 shares of common stock.

McDonnell Aircraft Corp.—**J. S. McDonnell, Jr.**, chairman of the board, chairman of the executive committee, president and director, $106,120 salary, 249,587 shares of common stock; **R. H. Charles**, executive vice president, member of the executive committee and director, $65,496 salary and 6,471 shares of common stock; **C. W. Drake**, vice president-manufacturing, member of the executive committee and director, $59,600 salary, and 10,213 shares of common stock; **D. S. Lewis, Jr.**, vice president-project management, member of the executive committee and director, $32,000 salary and 381 shares of common stock. **W. R. Orthwein, Jr.**, vice president-personnel and general services and director, $30,000 salary and 12,916 shares of common stock; **K. Perkins**, vice president-engineering, member of the executive committee and director, $54,420 salary and 948 shares of common stock; **L. Harrison**, vice president-procurement and quality control and director, salary not listed and 32 shares of common stock.

Following directors were not paid a salary: **W. A. McDonnell**, 5,781 shares of common stock; **S. W. Souers**, 1,146 shares of common stock; **J. E. Webb**, 1,081 shares of common stock.

J. S. McDonnell III and **John F. McDonnell**, children of J. S. McDonnell, Jr., are the owners of 115,678 and 115,283 shares of common stock respectively. Mrs. J. S. McDonnell, Jr., and her children are the beneficial owners of 2,096 shares of common stock of which 1,048 are in trusts of which J. S. McDonnell is trustee. J. S. McDonnell is a director of the McDonnell Foundation which owns 98,622 shares of common stock.

Financial Briefs

Servomechanisms, Inc., reported net earnings of $52,400 for the 1960 first quarter on net sales of $3,800,000, compared with a 1959 first-quarter loss of $97,400 on net sales of $3,200,000. Servomechanisms reported 1959 sales of $15,137,629 and a net loss of $194,968 or 24 cents a share compared with 1958 sales of $17,314,483 and a net loss of $43,094 or 5 cents a share. Backlog at the end of 1959 exceeded $8.3 million, compared with $7.8 million at the end of 1958.

Standard Coil Products Co., Inc., stockholders are being requested to approve a board of directors proposal to change the corporate name to Standard Kollsman Industries, Inc. Proposal will be voted on at the annual meeting June 14. Standard Coil makes television tuners but no longer produces coils. Its wholly-owned subsidiary Kollsman Instrument Corp. makes flight instruments and systems.

Boeing Improves 502 Combustion Chamber Dome

New combustion burner dome and liner of Boeing 502 series of small gas turbine engines allows use of fuels ranging from diesel and jet fuels to unleaded gasoline and kerosene without adjusting fuel control system, Boeing engineers say.

ENGINEERS:

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A Department of the Defense Electronics Division

GENERAL ELECTRIC

Northern Lights Office Building, Syracuse, New York

WHO'S WHERE

(*Continued from page 23*)

Changes

Lawrence Prybylski, director-personnel development, Trans World Airlines, New York, N. Y.

Alfred T. Germano, director-Customer Relations Division, Fairchild Astrionics Division of Fairchild Engine & Airplane Corp., Wyandanch, N. Y.

Jules Kravetz, director-government relations, Aerolab Development Co., Pasadena, Calif.

Harry L. Wolbers, chief of equipment and safety research section, El Segundo Division of Douglas Aircraft Co., El Segundo, Calif.

Allison Division of General Motors, Indianapolis, Ind., announced the following changes in the Aircraft Engines Operations: **William O. Watson,** technical assistant to operations manager, **E. M. Deckman,** manager-sales and contracts, **William E. Goohs,** assistant manager of manufacturing.

Edward J. Rhoad, senior scientist, Ground Systems Group, Hughes Aircraft Co., Fullerton, Calif. Other changes: **Charles E. DeBaker,** controller for product line operations; **Milton S. Higgins,** manager of project finance liaison for product line operations; **Tad Ichinokuchi,** controller of the manufacturing and parts service division; **David D. Wasson,** manager of industrial dynamics; **Jose M. Tellez,** manager of the Army computer systems department.

Lester L. Welch, manager of market analysis and planning, Autonetics, a division of North American Aviation, Inc., Downey, Calif.

A. S. Ginsburgh, manager of Materials and Fabrication Division of Aerojet-General Corp., Sacramento, Calif.

Ted Dunnegan, Jr., manager of the new project administration department, Temco Electronics, a division of Temco Aircraft Corp., Dallas, Tex.

James R. Vine, chief, computer applications, Systems Division of Beckman Instruments, Inc., Anaheim, Calif.

John J. Giba, manager, Tele-Dynamics Division of American Bosch Arma Corp., Philadelphia, Pa.

Dr. Richard W. Soshea, technical staff of research and development, Rheem Semiconductor Corp., Mountain View, Calif..

J. R. Witford, manager of Electronic Tube Division of Sperry Gyroscope Co., Great Neck, N. Y.

James R. Corcoran, Jr., appointed assistant to the vice president of Ogden Division of The Marquardt Corp., Ogden, Utah.

Capt. G. F. Wallis, manager of flight operations, North Central Airlines, Minneapolis, Minn.

Geoffrey Robillard, chief of newly formed Propulsion Division of California Institute of Technology Jet Propulsion Laboratory. Other appointments: **Robert F. Rose,** deputy chief; **Donnard R. Bartz,** chief of the Liquid Propulsion Research Section; **Leonard R. Piasecki,** chief of the Solid Propellants Rockets Section; **Anthony Briglio, Jr.,** chief of the Liquid Propulsion Development Section; **Dr. Robert F. Landel,** chief of the Solid Propellant Chemistry Section and **John J. Paulson,** chief of the Advanced Propulsion Section.

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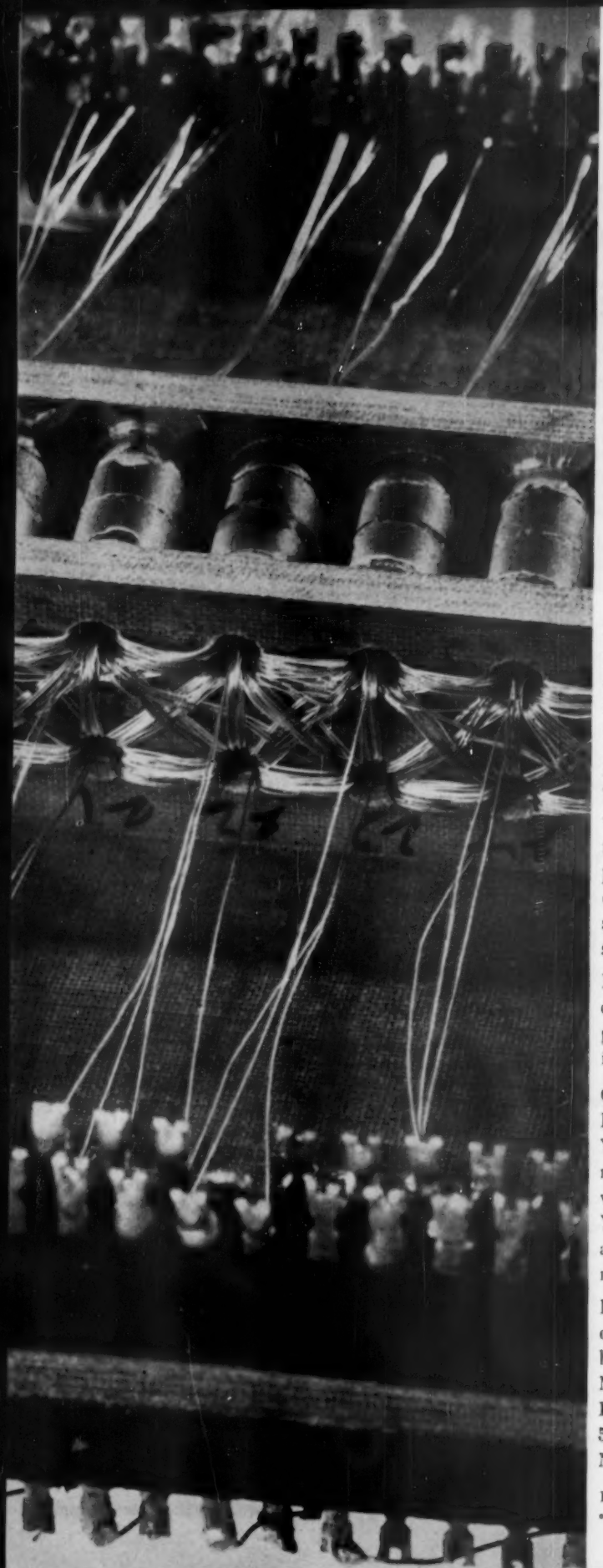

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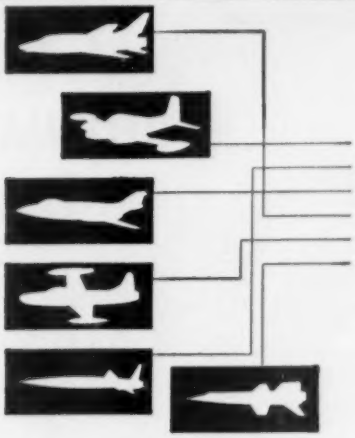

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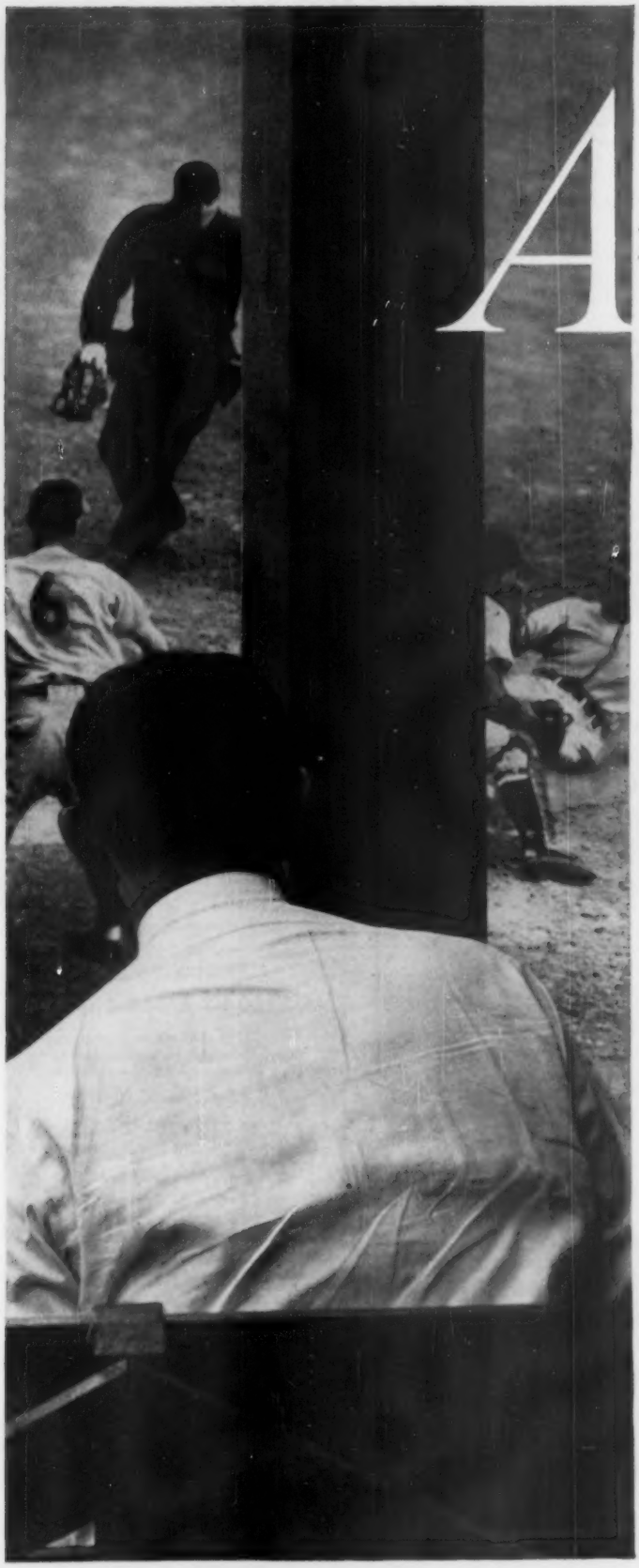

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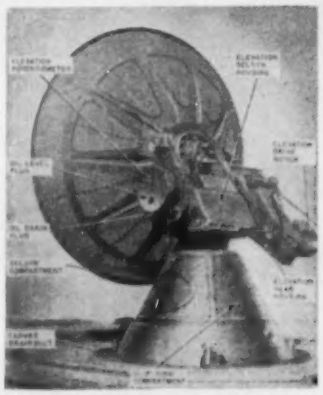

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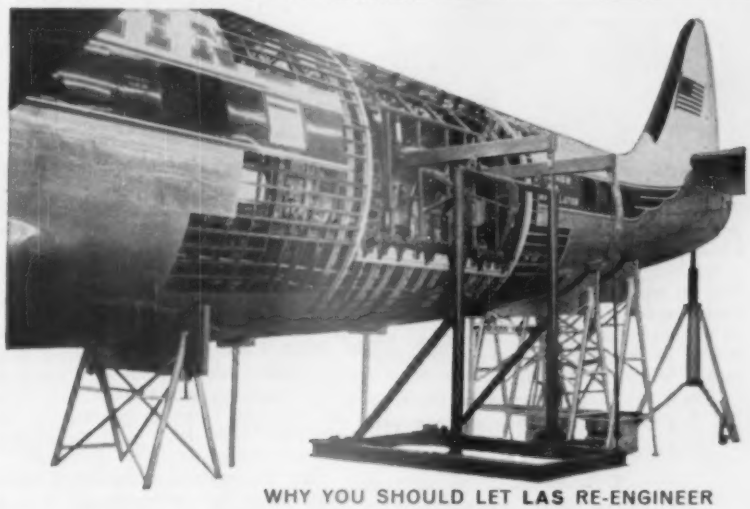

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LETTERS

Louisiana Landmarks

In your issue of Apr. 18 you have on p. 94 a picture of a radar map of New Orleans taken by a Texas Instruments side-looking radar. Apparently the pilot was guilty of an 80-mi. navigational error, as we seem to discern recognizable features of Baton Rouge. Since we are former students of LSU (in Baton Rouge) and Tulane (in New Orleans) we feel our navigational corrections may have some accuracy. According to our observations, the labels in the picture should be corrected as follows to identify the pertinent landmarks of Baton Rouge:

Huey P. Long Bridge—Mississippi River Bridge
Oil Storage Tanks—Correct (!)
Mississippi River—Good Guess
New Orleans Airport—Ryan Airport
New Orleans Sugar Bowl—Memorial Stadium

Perhaps the flight on which this photo was made originated from New Orleans during Mardi Gras, making such navigational errors entirely understandable.

E. J. Theriot
M. W. Wood, Jr.
Western Electric Co.
Greensboro, N. C.

(This letter is one of many received from sharp-eyed AW readers who also know their Louisiana landmarks.—Ed.)

Baton Rouge readers have sharp eyes—and they are right. The APQ-55 "New Orleans" radar map carried in your Apr. 18 issue is indeed of Baton Rouge, La. Murphy's Law set in when we presented Aviation Week with its APQ-55 map, and maps were switched inadvertently. We are enclosing another map of New Orleans (guaranteed) which shows how it happened; the bend in the Mississippi, the bridge, river boats and their wakes, all comprise a near-mirror-image of the New Orleans/Baton Rouge maps.

Naturally, we regret the accidental switch. But we are most pleased that the map's resolution survived the engraving process—so well that Baton Rouge readers had no trouble proving that TI knows radar better than it knows Baton Rouge.

R. J. Mitchell
Data Presentation Manager
Apparatus Division
Texas Instruments, Inc.
Dallas 9, Tex.

Flight Data Recorders

We were surprised that the otherwise comprehensive article in the May 16 issue of Aviation Week, entitled "Airlines Protest FAA Recorder Ruling," neglected to mention availability of the flight data recorder manufactured by the Technical Products Division of the Waste King Corp., Los Angeles.

The Waste King unit, as Aviation Week reported on Mar. 30, 1959, is a multi-channel instrument which can provide operation and maintenance information beyond that needed for accident investigation. Our flight data recorder enables carriers to record as many as 30 channels of information and all channels will survive accidents, per FAA specifications. The expandability feature of the Waste King recorder eliminates the danger of obsolescence should additional channels for accident investigation become mandatory at some future date.

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Boyd T. Marshall
Vice President-General Manager
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Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

FAA Doctrine

Mr. Robert Bose's letter (AW Feb. 29, p. 102) saddens me. He seems to have reached the point of suggesting boycott of flights of older pilots because of his worry over maneuverings of FAA and ALPA on the pilot retirement at age 60 rule and other issues. He qualifies himself as a passenger, not a pilot, and not connected in any way with the airline industry. This is most serious because it seems to invoke "the customer is always right" routine to which American business customarily bows.

With sympathy for Mr. Bose, I might also qualify myself by saying I sometimes buy a ticket but with an even more critical and experienced aviation eye than his. Nevertheless, I think FAA is off the beam on two counts regarding pilot retirement.

First, it's wrong for a democratic government to specify a retirement age to an industry if there is any other way in consideration of public interest to avoid doing so—and there is. Second, if it had to be done by specifying an age as the criteria—then FAA picked the wrong age.

As a non-airline pilot (25 years) with no special attachment for either ALPA or FAA, I thought it appropriate to personally check into FAA's doctrine. Consequently, I am of the opinion that FAA is not justified in smearing the older pilots of "the most select physical group in American industry" with the generalization that the "incidence of sudden strokes and heart attacks climbs sharply in men over age 60." (See AW Feb. 29, p. 47, where I borrowed the phrases.)

So, I would like to provide some comfort to passengers in the air and the public on the ground. Only I would like to include in the thought those older pilots who must successfully pass a medical and performance screening each and every six months of their flying careers.

Other safety factors being up to par, I would not hesitate to travel myself or have my family travel by airliner even if both pilots were 65. However, I would want to be assured that FAA's medical screening system was at least working as well as some other selective medical screening systems that I know of; also, that both pilots were fully "current and qualified" on the airplane, the airline's flying procedures, and "Pete's" other rules.

Robert E. Trimble
Washington, D. C.

Research Re-Emphasis

We spend too much time on research and development in this country.

We do research for a project and base the research on a limited amount of knowledge. And our knowledge is limited because the blood and sweat spent on basic research is woefully inadequate. In a competitive system this is understandable—but not forgivable.

Then, after the project enters production, we develop it ad infinitum (if it sells). This is mandatory because of the staggering cost of the initial research and development.

Modification, change, stretch, development is required to recoup the sums spent on research and development.

Basic research is the only way to increase our level of knowledge. Knowledge is not inexhaustible. With the geometric progression of life and progress on earth, we are depleting our store of knowledge at an alarming rate. It's even more alarming that the progression of life is continuous. We can't call a halt to progress so that the level of knowledge can be increased. If we don't spend enough for basic research today we can't make up for it tomorrow. We can do as much applied research and development as can be done in 50 40-hr. weeks per year and we will still run out of knowledge.

In a dog-eat-dog free-enterprise society no easy solution is obvious. One thing that must be avoided at any cost is complete governmental control of basic research.

A very small but significant beginning for re-emphasis of basic research can be made by magazines like Aviation Week. Professional people might increase their constructive thinking if the trade magazines would print one article a week concerning a particular problem requiring solution. The articles would not be easy to write and they would not be cheap. Worse, specific results would not be apparent immediately. But basic research is intended to be different than applied research.

Another, complementary approach to the problem would be for the technical societies to devote more of their time and energy to basic research.

Your readers may have additional suggestions for solving the problem.

James A. Martin
Lancaster, Calif.

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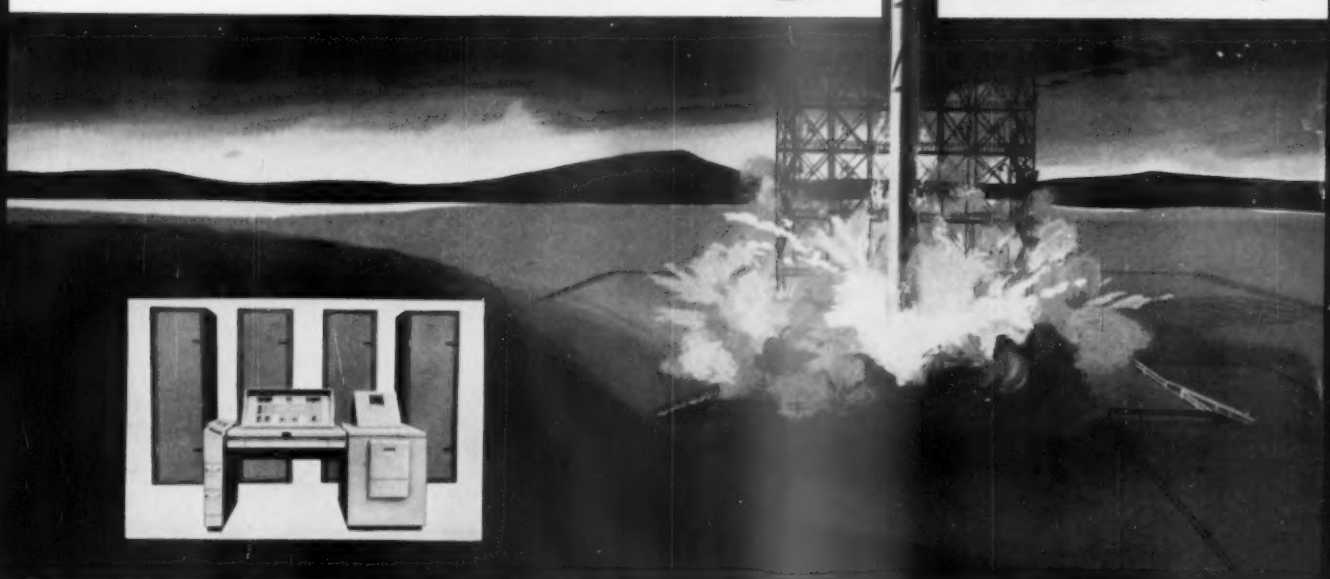

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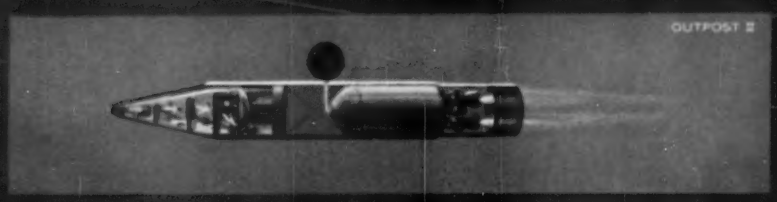

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